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General Article

DIFFICULTIES AND COMPLICATIONS OF THE EQUINE PREGNANCY DIAGNOSIS TEST*

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For the benefit of any who may not be familiar with the principles underlying the biological test of a sample of urine for its œstrone content, I may be permitted to give a short introductory explanation.

It has been known for a long time that the mare during pregnancy excretes in her urine large amounts of œstrone—the female sex hormone. Towards the end of pregnancy the amount present may reach very high levels—as much as 286,000 mouse units per litre (not Standard International Units) having been encountered in some of our cases. To discuss the origin of this enormous production is not perhaps profitable at present, but Catchpole and Cole (1934) in a quantitative study of the hormone content of the organs of pregnant mares and fœtuses, found evidence to show that the placenta would seem to be responsible for the production of very large amounts of it, and that the maternal ovaries, which are the seat of œstrone production under other circumstances, and the fœtal gonads are far less active in this respect than would have been imagined. Moreover, Hart and Cole (1934) showed that it is possible to remove the ovaries in a pregnant mare at the 200th day, without appreciably diminishing the magnitude of the excretion of œstrone in the urine subsequently. These latter authors also conclude that the source of the œstrone is probably the placenta and the endometrium.

The non-pregnant mare, provided she is not the subject of some pathological process involving the ovary, excretes very small amounts, and then only in close association with a period of œstrus.

It is upon a recognition of these two facts that the diagnosis of pregnancy by biological test is based. The test employed is that which is now generally known as the "cornification test." Oöphorectomised (female) mice are used and after suitable preparation of the urine, they are injected with small amounts in suitable dilution. The preparation involves the precipitation of mucin and other protein bodies to avoid protein shock in the test mice, the inhibition of bacterial activity (so-called "detoxication"), and neutralisation to a *p*H of about 7·0. Some 96 hours after initial injection, vaginal smears are made from each mouse. These are fixed, stained by Giemsa's method, and examined microscopically.

In positive cases, the appearance of the epithelial cells is quite characteristic; they have undergone a process of cornification or keratinisation, in which the nuclei are altered, the cytoplasm is swollen and hardened and much of the normal staining affinity is lost. These changes are collectively known as "cornification." Marked changes also occur in the uterus of each mouse, but since these are not utilised for purposes of diagnosis, they need not be described further here. In negative cases, the smear contains normal cubical epithelial cells, leucocytes, and strands of mucus, and only a very few cornified cells are seen.

This then, in brief, constitutes the pregnancy test as employed by us firstly in Edinburgh and now in London. At various times modifications have been made in the amount and frequency of injection, degree of dilution, ages of mice used, and a number of other technical details, but apart from minor improvements the principles employed are essentially those which have become almost universally adopted for testing for œstrone by using oöphorectomised mice. It should be emphasised* that this is not the Zondek-Aschheim Reaction.

It would seem that with a straightforward reaction, such as this, little or no difficulty should be encountered in deciding from the examination of a given sample whether a mare is pregnant or not. Actually there is no such difficulty in the great majority of normal cases, but it is well to emphasise (1) that even normal urine, in common with other excretory products, is subject to violent fluctuations in composition, related to the nature of the nutritive intake, the state of body metabolism, exercise, climate, etc.; and (2) that since the reaction in the test animals is a physiological one, it is liable to be compromised by individual differences in the mice themselves. Some mice are particularly susceptible to small amounts of œstrone;

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others are refractory or may exhibit temporary refractory phases. All mice can be made more responsive by an initial or "sensitising" dose, given two or three weeks before the test injections are made—a practice we follow when for any reason a batch of mice has not been used for some time. To avoid most of the sources of those errors which might be ascribed to the mice themselves, we use either four or five mice for each mare's test, and the results are based on a majority reaction. A rest of three weeks normally, and under busy conditions of at least two weeks, is provided between the dates of successive reactions. When considering variations in the urine samples submitted for test, however, there are practically no precautions that can be taken, other than those which relate to the actual collection of the sample. We prefer that whenever possible the specimen (it is not in the strictest sense of the word a *sample*) should be collected in the morning, so as to avoid the diluting effects which exercise, work, copious draughts of cold water, fear or other powerful emotions, and so on, might exert upon the concentration of œstrone in the sample. Urine which collects overnight in the bladder, and is voided first thing in the morning, is best for our purposes, and probably always is a more true reflection of metabolic processes than is that excreted during the day.

Contrary to what is stated in most text-books on Veterinary Physiology we have found that about 4½ per cent. of urine from mares of practically all breeds has an acid reaction—the acidity varying down to a *p*H of about 5·0. Under other circumstances, one would have expected an acid urine in the mare to be associated with some general febrile disturbance, but in none of the mares giving acid samples have we been informed of any general or local abnormality either by owner or veterinarian. In this connection, it has been stated that endometritis in the mare may be associated with acidity of the urine, but I have so far been unable to satisfy myself that this is always—or even usually—the case. I think, however, that it may be more often true in the cow, especially in those subacute cases which sometimes follow a difficult parturition.

May I perhaps take this opportunity to re-emphasise what has already been said previously. Reactions employing biological methods are subject to variations over which perfect control cannot be exercised. This applies to all biological substances whether vaccines, sera, tuberculin, urine or milk, as well as to the animals used for test purposes. *The enthusiastic supporter no less than the aggressive critic would do well to remember that invariability is not a biological phenomenon.*

Variations in the Response due to Duration of Pregnancy

In a previous publication (Miller, Greenwood and Blyth, 1934), it was pointed out that while most pregnant mares could be expected to yield samples which would give positive results by the 60 to 65th day, a certain percentage would give satisfactory results by the 42nd day. In the light of later experience, it must now be noted that some mares excrete œstrone in sufficient amounts to give good positive results at the 30th day after service; on the other hand, in one case tested every tenth day it was not until the 90th day that any indications of a positive response were shown, and not until the 100th day's sample was tested was a good positive obtained. This mare, however, stands alone; she is 18 years old and in the last three years she has been consistently slower than normal in mobilising her œstrone-production mechanism. These remarks refer to positive results obtained from mares which are ultimately reported to have foaled. With mares which give negative results between, say, the 40th and 60 days after service, it is, of course, impossible to distinguish the sample from a non-gravid mare from one from a pregnant mare which has not yet begun to excrete œstrone. In consequence of this normal variation, it is now our practice to discourage the sending for test of samples from mares in which less than 60 days have passed since the last service.

So far as the later stages of pregnancy are concerned, we have not had a single case out of over 2,000 in which a mare more than 120 days after service has given a negative result and has ultimately proved to be pregnant. We have, however, had a considerable number of mares—(too large a number for my own peace of mind) — in which perfectly good and apparently normal positive results were obtained —sometimes in two successive tests—and yet ultimately these mares did not produce a *living foal*. (I use these last two words very advisedly.)

Results Obtained During Last Season

During the season 1934-35 (that is, with mares due to foal in 1935), the number of these apparently erroneous results rose to greater proportions than previously. Before the results for this year came in we recorded an accuracy of 99·0 per cent. for 648 mares (in 1934), and there appeared to be good reasons for believing that we might maintain this high level of accuracy. This expectation, however, has not been fulfilled. Unfortunately, many of the results for 1935 have not yet been received—there are some 727 mares for which results have not come to hand and it is impossible, consequently, to deter-

mine the exact proportions. Up to date we have had reported 21 cases in which a mare between June and December gave a positive reaction but did not eventually prove to be pregnant. I am very much afraid that I shall ultimately find this figure to be considerably increased when all results are received. Some of these mares were retested again during the winter months. Four gave a negative result, but four others gave a second positive reaction, and I confidently assumed that these latter were pregnant. Later, however, they were reported barren, and it became necessary to seek some explanation of the discrepancy.

It was first necessary to discover whether there were any suspicious symptoms subsequent to the taking of the first sample for the test, which might point to abortion of the fœtus. When this possibility was suggested to owners we found strong evidence that it had occurred in at least three cases, and the circumstances were at least very suspicious in one other.

There seemed no likelihood, however, that abortion had occurred in the remaining 14 mares. We knew from previous experience that mares with advanced cystic ovaries might excrete up to about 3,000 M.U. of œstrone per 1,000 mls. of urine, even though non-pregnant. An examination of the case histories of some of these positively reacting mares which did not ultimately foal, and correspondence with the owner and veterinary surgeon, revealed that in three cases at least we could assume that cystic ovaries had probably been responsible for the excretion of a sufficiently large amount of œstrone in the urine to give on test a positive result pronounced enough to lead to the diagnosis of pregnancy. One of these mares has since been killed and I have extracted from her ovaries 1,771·0 M.U. per gramme, of œstrone. (I might mention, as an interpolation here, that to date I have examined four pairs of ovaries from mares destroyed for signs of nymphomania or because they failed after repeated attempts to breed a foal, and in six ovaries, each of which was cystic in greater or lesser degree, I have been able to recover quantities of œstrone far above the amount normally present.)

To account for the remainder of these erroneous results it has not been possible to reach any conclusive proof. I might, however, dispose of one case first, which, when examined by a veterinary surgeon some ten weeks after the assumed foaling date, was found to contain a mummified fœtus, and another in which for some reason the placental fluids had been absorbed and there were fragments of a liquefying fœtus present, most of which—including several recognisable ribs—were removed manually. Although I include these two and the abortions among the "errors" of the test, they are, obviously not errors in the strict sense, though when an endeavour is made to explain their occurrence, or the possibility of their occurrence, to the lay owner (and occasionally to the veterinary surgeon), I have usually the feeling that they are not by any means convinced that such might apply to their mares. There still remain to be explained the errors in such mares as did not abort, showed neither by behaviour nor clinical examination any symptoms of nymphomania or cystic ovaries, and in which there were no apparent signs of mummification.

Fœtal Atrophy and Vitamin E

Hammond (1914, 1921, 1925, etc.) has shown that a selective fœtal death and subsequent atrophy occurs far more commonly in sows and rabbits than is generally supposed. His work has been confirmed by many observers since. Mattil and Conklin (1920), Evans and Scott (1922), and Sure (1923), and since them many other workers, have demonstrated the existence of a specific substance which was necessary for reproduction in male and female rats. Further work led to the identification of the now well-known vitamin E—the anti-sterility vitamin. When carrying out genetic work with considerable numbers of sheep in Scotland during the last few years I have found strong evidence of the not uncommon occurrence of a similar fœtal death and atrophy (with occasionally mummification) in mountain ewes kept on hill pastures, especially on poor quality hill grazings, and in particular when there was severe weather and late storms (from February onwards) such as occurred in 1933 and 1934, when the herbage was badly checked and the grass was slow to grow. An explanation, based on an insufficiency of calcium and/or phosphorus has been advanced, but whatever the cause of the condition, it is associated with, and intensified by, severe weather and backward grazings.

These facts led to a consideration of the possibility of a somewhat similar phenomenon occurring in the mare. In this connection, it is difficult to find any *ad hoc* experimental work which will substantiate the view that fœtal death and atrophy or resorption might occur with any degree of frequency, but it must be borne in mind that the mare does not lend herself readily to accurate experimental work of this kind, and one has to fall back upon observation and deduction. I am consequently driven to what might perhaps be described as circumstantial evidence and surmise.

The summer of 1933 was exceedingly dry. The summer of 1934 was, in England and Ireland, even worse, though over most of Scotland

more rain fell and on the whole pastures were never burnt brown as they were here in the south. This is an interesting point, since from Scotland only one case of a positive error has been recorded. I made a point of enquiring in what way a number of breeders endeavoured to augment the poor quality of their grazings, to be told that most considered that it was enough to feed lactating and pregnant mares with an additional allowance of oats, bran, maize (flaked), and hay (ryegrass, lucerne, clover, sainfoin), or mixtures of some of these.

It is, I think, reasonable to postulate that the normal pregnant and lactating mare can store in her tissues vitamin E, just as other vitamins can be stored, and just as the female rat can store vitamin E (in muscle, etc.); and further that she can call upon these reserves in times of scarcity for a certain length of time. This is well authenticated for the rat, in which an accumulated store is sometimes sufficient to provide enough vitamin E for one or two successful pregnancies even when fed upon a vitamin E-free diet subsequently.

Such a suggestion might well explain why the results of the 1933-34 season, as judged by the number of foals born, were better than the 1934-35 season, when in very many studs the percentage of infertile mares was, if one can judge from the accumulated opinions of breeders and veterinary surgeons in attendance, far higher than normal. It is, however, not possible as yet to give statistical evidence to support this contention. The figures are being accumulated slowly at present.

I would like to draw attention to two pieces of what may be regarded as supporting evidence. A sufficiency or an excess of vitamin E has been shown by Verzár (1931) to result in a stimulation of the genitalia in female rats very similar to that induced by the anterior pituitary gonadotropic hormone. Though vitamin E is not normally credited with the initiation or intensification of œstrus as one of its functions in the rat, there is evidence to support the suggestion that it is at least concerned in the synthesis of the anterior pituitary hormone, and that in a period of deficiency, œstrus is liable to be irregular, though it must be admitted that this is not always or necessarily so. If we examine the history of the early part of the 1935 mating season, we find that it was a common complaint that mares were unusually late in coming into season, and showed a tendency to remain in season for a shorter length of time than normal. Many showed very irregular periodicity. It has been suggested that this was mainly due to the very cold dry east winds which were common then, but this does not seem convincing, for in previous years the weather has been much colder, and, so far as I know, irregularity in œstrus was not recorded then. On the whole, the early part of 1935 was milder than usual. I make the suggestion that much of this irregularity is directly ascribable to the poor grazing season of the summer and autumn of 1934, and that since it was not experienced in two studs where an examination of the feeding showed that adequate supplies of vitamins and minerals were included in the rations, it may reasonably have been due to a deficiency of either or both of these substances. I should like to observe here that since we now know how important it is that, for example, calcium should be associated with vitamin D (the " calcifying " vitamin) it requires no excuse to associate vitamins *and* minerals together.

The second point I should like to make in this connection, is that from reports from a number of veterinary surgeons, the past season seems to have been one in which practitioners have been called in to deal with more cases of dystokia, more weakly under-developed foals have been born and there has been a greater insufficiency of milk in mares, than usual. Moreover, owners have reported that in a large number of cases mares which foaled normally showed an extended gestation period, in one or two instances remarkably extended—up to 12 or 12½ months in some cases. So many factors enter into the causation of lengthened or irregular gestation in the larger animals, that it is perhaps unwise solely to incriminate any one, such as vitamin or mineral deficiency. Individual variation is notoriously marked, but when a larger number of mares than usual behave in similar fashion, it strongly suggests a common factor. It can be assumed that, since horse breeders and perhaps especially the breeders of thoroughbred horses, are as a whole cautiously conservative (and rightly so, for a thoroughbred mare is an expensive animal with which to experiment), the treatment of the mares did not differ in any wholesale manner from the practice which was usual previously in this or that stud, and that anything of the nature of a common factor is to be looked for in climatic or seasonal variations over which no control can be exercised.

The Vitamin E Content of some Common Foodstuffs

It will be useful here perhaps to give a short list, taken from the Medical Research Council Report on Vitamins (1932), of the vitamin E content of a few of the commoner foodstuffs, some of which are used for horse feeding. Though perhaps a more up-to-date list might be prepared, the above work is at least quite authoritative.

Foodstuff.	*Amount as Tested on Rats Anti-sterility Value.*
Oats (whole)	+
Rolled Oats	Very little.
Maize (whole grain) ...	+
Flaked maize	Very little.
Wheat (whole)	+
Lucerne—green	+ + +
Dried Lucerne	+ + +
Lettuce fresh	+ + +
Dried Lettuce	+ + +
Sprouted peas	+ + +
Green grass	Very high.
Green legumes (fresh) ...	Very high.
Oat germ oil	+ + +
Wheat germ oil	+ + +
Maize germ oil	+ + +
Cod-liver oil	Variable 0 to + +

In view of what has been said earlier, an examination of the above will show that, with the exception of lucerne hay, in the absence of an adequate supply of green grass in summer, or green lucerne or legumes, the mare has a very restricted source of supply of vitamins and salts unless special measures are taken to ensure their presence in the food.

The Results of Insufficiency of Vitamin E

So far I have not indicated perhaps very clearly what are the consequences of a deprivation (and in lesser degree a deficiency) of vitamin E upon the pregnant female, nor what results follow a deficiency of minerals (especially calcium and phosphorus). The work on man and the larger animals is, up to date, somewhat scanty, but one may mention that Vogt-Moller and Bay (1931) have shown that in the form of wheat germ oil, vitamin E may be given by intramuscular injection to healthy but sterile cows with good results; while in the human female it has been used similarly to prevent miscarriage in individuals who in previous pregnancies were repeatedly subject to this condition. These reports suggest that a lack of this vitamin may be associated with some forms of infertility in cows and for miscarriage in the human, but they only give a general indication.

In the pregnant female rat, however, the effects of deprivation of vitamin E are much more precisely known. If it is withheld in the diet, the fœtuses, instead of being born at full term, die in the uterus and are resorbed. At first, signs of retarded development are shown, generally about the eighth day, and fœtal death occurs at about the 13th day (that is at slightly over half the normal gestation period of the rat, which is 21 to 22 days). Absorption of the fœtuses is completed by the 19th or 20th day. The cause of death is atrophy and degeneration of the allantois, which leads to starvation and asphyxia of the fœtuses. Apart from the evidence obtained from careful observation of regular periodic weight recordings of the pregnant rats, there may be no external symptoms to indicate that death and resorption have occurred. This is, I think, important to remember, for, although one cannot argue from rats to mares, it would account for the difficulty that an owner has in believing that anything abnormal has happened to such of his mares as gave positive results to the pregnancy test but did not foal at term. He does not, of course, periodically weigh his mares as a check on the course and progress of pregnancy. One cannot but feel that it is a great pity systematic weighings of the larger animals—including cows and bullocks—is not made more common. It may be that fœtal death and resorption of this nature is far more common in mares generally, than is realised. It may be that, quite apart from the incidence of a particularly unfavourable season, such as 1934, many brood mares, served in the usual way, which do not eventually produce a living foal are erroneously considered not to have been pregnant in that particular year. It is common knowledge that the symptoms of pregnancy are frequently misleading or indefinite; it will be within the experience of all of you to have been forced to admit difficulty in deciding whether a mare was or was not pregnant, from clinical evidence only. If the suggestion regarding the occurrence of fœtal atrophy in the mare is ultimately shown to be correct, it can be said that it remained for a pregnancy diagnosis test to bring to light this aspect of a very knotty problem. There is in any case opened up an avenue which may well repay exploration. The so-called fertility percentage of stallions varies between about 50 per cent. and 60 per cent. of the number of mares served, though it may fall as low as 40 per cent. Even with King's Premium and Super Premium Stallions it has fallen as low as 49·38 per cent. (in 1929). I mention these stallions especially because normally they show a higher foal production rate than thoroughbred stallions used for purely thoroughbred stud breeding. Admittedly much of the cause of this infertility must be looked for

(i) in the system of breeding, whereby a mare though in season is not served at the optimum time for fertilisation of the ovum to occur (*i.e.*, the penultimate day of the heat period);

(ii) in early abortion or failure of the embryo to secure permanent uterine connection between the sixth and ninth week after service—that is, after the yolk stalk has ceased to maintain its primitive attachment;

(iii) in various other calamities which may overtake the embryo or young fœtus at a later stage in pregnancy;

and (iv) probably most important of all, in that group of pathological and physiological abnormalities of the generative organs, which includes chronic infective and inflammatory conditions—endometritis, cystic or fibrotic ovaries, tumour formation, and all that is contained within the phrase "hormonic imbalance," whether at œstrus or later. More strictly, however, these latter factors are the cause of sterility rather than infertility.

I am not, however, at all convinced that these causes mentioned are sufficient to account for one of every two mares served being barren, nor for even this proportion being exceeded in close relationship with an unfavourable year. From the evidence* which I have been able to collect, far from complete as yet, I am strongly inclined to consider that many mares, at any rate during last year, which were safely in foal in the early part of the season—that is, until about the end of the first half of pregnancy—but which did not eventually produce a foal at full term, suffered fœtal death and resorption similar to that which occurs in the female rat deprived of vitamin E. I should have liked to have been able to give comprehensive results from studs where some endeavour is made to supply adequate amounts not only of vitamin E but also of the other vitamins, and of calcium and phosphorus, to mares during pregnancy, especially where the mares are called upon to withstand the added strain of lactation. These results, apart from two particular cases where cod-liver oil and minerals had been fed previously, will not be ready until another season. In the meanwhile, all I can say is that results are encouraging. I have not sought permission to quote actual cases by name, but I might mention that, in one such stud, out of 20 mares served, 19 produced foals, while in the second one, from 26 mares, 24 foals were born. These are both instances of the results of supplementary feeding, and they compare with results from other studs where no especial feeding was undertaken, such as eleven foals from 17 mares; 12 foals from 19 mares; six foals from 14 mares, etc., to take examples at random from results sent in or reported verbally.

May I again interrupt myself here to point out that in the mare, just as in the human being, the cow, sow and the laboratory animals, lactation and pregnancy occurring simultaneously throw a tremendous strain upon the powers of the individual. Human gynæcologists are unanimously endeavouring to persuade their patients to avoid greater frequency of pregnancies than once in two to three years. If circumstances would permit the same kind of spacing of families in cattle and horses, I should be surprised if many of our present breeding troubles did not disappear. Many cases are on record of mares and some of cows which breed normally and satisfactorily only every second year. After each parturition, Nature calls a halt in the reproductive cycle, service is unfruitful and a year's rest results. Subsequent service is successful and the phase is repeated. Man in his hurry, however, wants one foal and one calf per year from each dam. It seems only simple logic to say that, this being so, he should provide his brood females with the necessities for each production. Moreover, there is a further aspect. There is abundant evidence to show that the foundations for the health and success of the individual are laid in the maternal uterus. To produce best quality offspring a beginning must be made with the feeding of the pregnant dam. In the mare, where some 50 to 70 lb. of fœtal bone must be laid down, the demands for calcium phosphate made by the fœtus exert a very considerable strain upon the maternal metabolism, even without the added drain upon the calcium reserves made by lactation. If the mare is not to be given time to build up her inorganic reserves from the food alone, then some additional minerals must be supplied to enable her to produce the best foal of which she is constitutionally capable, and she must have adequate vitamins to enable her to utilise these minerals. I would like to suggest that during the last 4½ to 5 months of pregnancy at least, that is, when the fœtal bony and cartilaginous tissues are making their greatest demands on the maternal calcium reserves, all pregnant mares should be given minerals in a form which most nearly approximates bone itself. In this respect, steamed or sterilised bone flour is better than nothing, but a far better product is a form of "undenatured" bone meal, in which, as the result of great care in preparation, the product possesses considerable quantities of protein (largely in the form of essential amino-acids; fats (which are necessary for calcium assimilation) and moreover has a high biologic value which cannot at present be readily defined in precise terms. Such substances are now on the market and have given remarkably good results with cattle and sheep.

It must appear to anyone who searches records of experimental work, even of an observational nature, carried out on breeding horses, that apart from specific diseases, very little effort has been made in this country to throw light upon many of the problems involved. The

* This evidence is based upon the positive results of tests together with the confident opinion of owners, veterinary surgeons, etc., later in the season when the signs of pregnancy were more advanced.

whole subject of the feeding of horses is one which urgently requires investigation. Compound proprietary remedies of unknown composition when added to the rations undoubtedly do effect marked improvement in very many cases. Some of these on the market at present contain preparations of vitamins and salts, and are being used with considerable success, but they are *secret* remedies and as such, to say the least, do not commend themselves to the scientific mind. There can be but little doubt that the owner of animals is not infrequently laid open to exploitation by unscrupulous firms. Sound, standardised products are on the market, and it would seem that the veterinary surgeon in his capacity of adviser might do much to enable the livestock breeder to achieve better results were he to interest himself more actively in the details of feeding.

Finally, I should like to make it clear that I have not attempted to give a paper with clear-cut results of experimental work, but rather have I endeavoured to indicate a series of problems upon which any two people may readily hold divergent views, but which may perhaps result in a stimulating discussion on a very fascinating subject.

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Discussion

Observing that the paper was now open for discussion, the Chairman (Major E. S. Martin) said he would like to inaugurate that discussion by contributing a few words. He happened to live in a place where it was a very rare thing to see a mare in these days, but during his War services they had a large number of in-foal mares and they also had to make rectal examinations. He desired to ask Professor Miller the exact circumstances in which this test was of real use and how soon after service the test responded? Normally a mare came into season about every third or fourth week. If she had failed to become pregnant, could they not tell from the normal recurrence of œstrum? He called upon Mr. G. P. Male of Reading to open the discussion.

Complying with the Chairman's invitation, Mr. G. P. Male said he wished personally to thank Professor Miller for so kindly giving them the results of his work and also for so frankly discussing its difficulties and complications. "I am very pleased to open this discussion," Mr. Male continued, "because having done a little work in genetics myself no one appreciates more than I the vast field which is still unexplored and the variations which may arise when dealing with living animals; also the difficulties of obtaining reliable data. Whenever one is dealing with biological products there are bound to be idiosyncrasies of individual animals, whether one is applying the tuberculin test or doing such intricate tests as this with animal products tested on other smaller animals, in this case the mouse. Professor Miller has worked out a very clever technique of his own, following the lead of Aschheim-Zondek, who I believe first demonstrated the presence in pregnant females of a hormone which produces marked changes in the genital organs of experimental animals, causing a condition of œstrum. Whether the placenta is mainly responsible or whether for a time the anterior pituitary also contributes has not, I believe, been definitely decided: possibly both operate at different times. American workers, Cole, Hart, and Catchpole, recommend the use of blood serum instead of urine and use the immature rat as the experimental animal. In this way they claim that an earlier diagnosis can be made, that the results are more reliable and that pathological conditions do not affect its accuracy. On the other hand, this test cannot be used after the fourth month and it has the objection that blood might be more difficult to obtain than urine, especially from thoroughbred mares, so no doubt Professor Miller has very good reasons for using the test he has described to us and with which he has been most successful. I was rather interested in his remark about the acidity of the urine. It has been said for many generations, I think, that some mares will not breed because the discharges from the vagina are acid. Whether that has been worked out or not I do not know, but it is rather interesting to learn that in some cases the urine is acid and possibly therefore the vaginal discharges might also be

acid. From statistics given by Professor Miller he is rather disappointed that the results of the 1934-5 season have not been so satisfactory as those of the previous years, and I must say I also share that disappointment as it has given an excuse for the appearance of certain American experts who this year have gone round some of the most noted studs in this country and on the Continent making clinical examinations of mares for pregnancy and claiming 100 per cent. results. Of course any experienced veterinary surgeon could do the same, though great care has to be exercised to eliminate risks of abortion. One can diagnose pregnancy by exploring the rectum, by the condition of the mucous membrane of the vagina and the appearance of the *os uteri*.

Although I agree with much that he says as to the feeding of in-foal mares to ensure an adequate supply of minerals and vitamins, and the effects that a want of these substances has on fertility, I cannot follow the theory he advances that because we had two dry seasons vitamin E was so depleted that it caused in many cases the death and re-absorption of the fœtus. It is an ingenious theory, but not convincing, and it is contrary to one's own experience and observations for many reasons.

Unfortunately, I have only had this paper for a few days and this has given me very little opportunity to get statistics and the histories of the mares that did not bear out the findings of the test, or of studying all the books of reference to which he refers, but it just happened that on the morning I received my copy of the paper I was at a stud where the findings last season in four out of seventeen cases did not tally, and so I made very careful inquiries. I found, in the first place, that the grass was always plentiful in both these seasons, owing to the special manuring that had been applied, following a chemical analysis of the soil. I may also say there was not a great number of animals on the stud compared with the acreage of the grass, and there could never have been any want of good grass during the whole of that season. At any rate, there should have been a sufficient supply of minerals and vitamins; the mares also were in good condition. Of the four that gave positive reactions two had been seen in season and were not expected to be in foal. On another stud two mares gave a positive reaction although the specimens were taken well after the 60th day, but later on when again tested they were negative. Both these mares had been seen in œstrum before the first sample was taken and were not expected to be in foal. There again they took very great care of the grass and I do not think one can say, from one's own observation, that there was any lack of good grass. The mares were also in good condition. In one case where pregnancy was diagnosed by the test the mare had been barren for some years, but in this animal the ovaries were diseased and, as a last resort, I implanted the ovaries of another mare, which did not prove successful. This I may say was the first case in this stud out of eight grafting operations in which a successful result was not obtained. I sent the ovaries of this mare to Professor Miller and he confirmed my diagnosis of disease, and I think he will agree they were decidedly bad. I mention this because I think it is possible that many of these cases of irregular reaction may be due to disease or dysfunctioning of the ovaries, and we know that in the human subject other pathological conditions affect the test. There is also the human element. I have had specimens of fæces sent to me without even the name of the owner, much less the animal to which the specimen belonged, and among the large number of animals examined might not quite a number of errors be due to this factor?

The contention that 1934-5 was a bad breeding season is not, I think, borne out by statistics, nor was it my own experience. I am not sure also that owners are to be entirely relied on, as we hear every year that mares are coming into season slowly and are difficult to get in foal. That is always the cry of the stud grooms and I take very little notice of it. My worst season in this respect was, I believe, 1932-3 when it was wet and cold. I find mares and foals do better at grass in the dry seasons than in wet ones. I have been able to obtain the fertility percentages of stallions over a number of years and I find there is very little variation from year to year. I have also the Hunter Improvement Society's and the King's Premium statistics for 1934 and the percentage of foals was 54·66, which is I think well above the average; in fact, the third highest since 1917. The latest percentage figure for heavy horses was 58·3 and here again there is very little variation from year to year. Although in the smaller animals where the young are numerous re-absorption of the fœtus may take place, has any case ever been demonstrated in the larger animals with one fœtus, or in the human subject? I can understand a mummified fœtus being found, though that must be extremely rare, but for the hard structures to be completely absorbed seems to me to be doubtful. If I may be allowed to offer an explanation of these irregular results, I would put them down to early abortions, disease of the ovaries or dysfunctioning of the ovaries—and that is more common than many think—and possibly, and here I am open to correction, to the mice becoming hypersensitised by frequent use and perhaps reacting to just a slight quantity of œstrone that might have been present in the urine of mares that were in season.

I agree with Professor Miller more or less as to the causes of infertility, but he seems to have missed out the stallion, which is an important factor, especially in thoroughbreds. I have found that the stallion is very often responsible for a large number of mares not breeding. In one stud I know 30 mares were served and only four got in foal; and I could give other examples. With regard to the time for serving, I would prefer the third day from the end of the heat to the second as the best day for the service to take place. According to Marshall, from the third to the fifth day is the best time for service. Mares vary very considerably in the length or duration of heat, and if the service is too early the spermatozoa die, and if too late the ovum has already been expelled and gets too far down the genital canal to be fertilised, and Marshall points out, I think, that many mares are infertile because they are not served at the proper time for fertilising the ovum. My own view is that if more attention was paid to this question of service we should get a lot more mares in foal. We have an example in the ponies that run wild in America and in our own Forest ponies, where almost regularly you get 100 per cent. of foals. These mares are subject to the same weather conditions as are our own, with dry seasons following each other, but that does not cause re-absorption of the fœtus in their case. I think we have to look beyond that for these irregularities.

I am sure all of you want to say something on this very interesting subject, therefore I will not detain you further except again to congratulate Professor Miller on his very fine work which, I can assure him, we very much appreciate. I also hope he will not be discouraged by his temporary disappointments and that he will be able to show us 100 per cent. results next year.

Mr. N. S. Barron remarked that Professor Miller's paper had given rise to an enormous number of controversial points, but there were one or two he would like cleared up. This test naturally was more beneficial and more economical when applied to the horse, but he would like to know whether the Professor had carried out the test at all extensively with other animals, and whether it could be applied in the same way. He had heard, for instance, that the goat was not a satisfactory animal to which to apply the pregnancy test but that sheep and cows did respond. Again, it was fairly well known that the vitamin A content of grass varied throughout the year and that it was at its height or its peak with regard to richness in spring, and again later on in the year. Could Professor Miller tell them whether this also applied to Vitamin E?

Mr. W. F. Maynard observed that he was in much the same position as the Chairman in that he did not see many mares now, but speaking as a country practitioner, one of his great difficulties when the stallion came round was to decide the time when the mare should be served. How long did the period last when she should be served, and could one have some more definite evidence as to when was the proper time? It was surprising to him that they got any in-foal mares at all.

Mr. T. A. R. Chipperfield wished to ask either the essayist or Mr. Male whether he had tried or compared the results of gland grafting with those of the administration of glandular extracts for the dysfunctioning of the ovaries and, if so, what he had deduced from it. With regard to the use of wheat germ oil, his experience was that it had no effect or produced no pathological change in the case of chronic endometritis. He would also like to ask what was the actual hormone that controlled the duration of pregnancy, and the onset of lactation, and further, what was the function of the corpus luteum.

Mr. J. B. White asked Professor Miller what natural food he would recommend giving either mares earlier in the year or cows later on, as a means of supplying them with vitamin E. Professor Miller had mentioned that lucerne was one very good thing and sprouting peas another. Professor Miller had also mentioned a special bone product which was preferable to steamed bone flour: would he tell them what it was?

Mr. J. A. Craft enquired if Professor Miller had noted any difference in the results of the different tests; for instance, what would be the difference in the blood test and the urine test apart from the getting of the product? Something had been said about acid urine. He had always understood they did get a condition when the animal was acid, and would not conceive. Mr. Male had mentioned possible secretions, apart from the urine, that were acid. Personally he thought that was borne out, because their method used to be to wash out with an alkali, but it would be interesting to find out if there was such a thing as an acid secretion, which did definitely prevent pregnancy. With regard to the feeding, the great question that arose in his mind was the correct method of feeding mares, especially when they had seasons such as those of the last few years. What was the vitamin content of the luscious growth they got as an aftermath? Then again, with regard to pastures, which ones had the higher vitamin and salt content—those which had received artificial manures, or those which had been correctly grazed? By correct grazing one must provide the grass with a tremendous amount of artificial food. He made it a principle to give extra feed to all animals running out, whether summer or winter, in order to ensure that more was not taken out of the pastures than was put back.

Mr. G. Warnock Begg, who was also invited by the Chairman to take part in the discussion, remarked that he had been very interested in the highly technical paper Professor Miller had given them. He was rather in agreement with him that dry weather did affect the settling of farm stock and in saying this he had particularly in mind the case of sheep in the north of Scotland. The taking of statistics with regard to horses was very different from getting them for ordinary commercial stock. The average man took far more interest in his mare than he did in several cows. The loss of a foal to a farmer was something he remembered for years, whereas the loss of half-a-dozen calves would be forgotten in a few months. He would like to hear of any statistics with regard to cows, and if any work had been done in this direction with cows, sheep, or even with pigs. He would also like

to know when reaction ceased in the case of a mare aborting. If she aborted, did the reaction cease in a few days or was it a matter of weeks or even months? He had enjoyed the paper very much indeed and he was glad he had had the opportunity of listening to it.

The Reply

Professor Miller said he would like to thank the various members for the many points they had brought up. It was going to be no light task to reply adequately to all the points raised, and some would have to await further work and information.

Mr. Male had mentioned the blood test as used by the American workers. The results obtained seemed to be better than with urine during early pregnancy, but the difficulties and prejudices against taking samples of blood from thoroughbred mares made the urine test a more popular one in Britain. He had done a certain number of tests of blood for gonadotropic hormone, but would not like to say much more than that meanwhile. The chief disadvantage was that the concentration of this hormone in the blood stream fell to very small amounts by about the hundredth day after service, so that the test could not be used later than this, and in some mares it fell earlier. Moreover, there were difficulties with the test animals. The mice (or rats) had to be young females, they had to be used prior to puberty, and it was necessary to maintain almost impossibly large numbers of breeding stocks to ensure that at any given time there would always be an adequate supply of these young virgin females available for the irregular numbers of samples which might come in on any given day.

The question of acidity of the vaginal discharges was one which required investigation. This was an example of where the practitioner himself could best contribute something useful. He in his daily round had far more opportunity of determining, even roughly, whether vaginal secretions were acid or alkaline. He would be glad to hear that some of those in a horse breeding practice would undertake to throw further light on this point.

He noted that Mr. Male did not feel inclined to agree that in the past dry seasons the cause of the errors in diagnosis might be the lack of vitamins or minerals. Mr. Male had, however, strongly supported the contention that the percentage of fertility among breeding mares was really appallingly low—even the best results did not reach 60 per cent. He (Professor Miller) suggested that that figure was sufficiently low to indicate that even under what could be called *normal* conditions something was very far wrong, and he had meant to imply that—quite apart from the past two seasons' experience—dietetic deficiencies might readily be a contributory cause. He agreed with Mr. Male that a considerable proportion of the current infertility should probably be blamed upon the stallion, but he had meant to confine attention to the female only. The whole question of male infertility and sterility was a subject by itself, into which there would be no opportunity to enter at present.

He had to accept the fact that errors could readily arise from mistakes made by grooms and owners. He had evidence that it might be possible that some unscrupulous persons might send urine from one mare under the label of another. The only safeguard against this happening was to have the sample collected under the supervision of the veterinary surgeon—even he made mistakes sometimes.

He would rather not enter into an attempt to give explanations in the specific cases raised by Mr. Male, since he had not details of the tests concerned available. He would agree with Mr. Male, however, that errors might occur from hypersensitisation of test mice. The point had not escaped attention, but there was so much individual variation that it was difficult to arrive at a general conclusion. Each batch of mice used had three weeks' rest between the end of one test and the beginning of another so far as possible, but occasions did arise, during busy periods, when this could not always be managed. In time it would probably be possible to build up a big enough stock to ensure a longer rest.

There was a point regarding absorption of fœtuses. It had been shown that it was possible for death and resorption to occur in the rat at a little more than half way through the gestation period. Admittedly one could not always argue from rats to mares, but he found no difficulty in believing that a four- to five-months-old equine fœtus might die and be resorbed at this stage. Normally such a fœtus measured 15 in. to 18 in. long and it should be remembered that the great increase in size occurred from six months onwards. Bones were not ossified, and the soft tissues were very immature. There would be still some five months for the process of resorption to take place. The matter was, however, not yet proved and meantime it was of the nature of a suggestion only.

In reply to Major Martin, Professor Miller thought that it was desirable to emphasise that œstrus in the mare, and perhaps especially in the thoroughbred mare, was often very irregular, so that it was not possible to depend upon its exhibition or its absence alone for a diagnosis of pregnancy. Rectal examination gave positive evidence in the later stages of pregnancy, but in some mares this was difficult without severe restraint, which might lead to injury and abortion, while it was notoriously difficult to make an accurate rectal diagnosis in early pregnancy. The usefulness of the test, he thought, was greatest in such cases as these, and he would like to point out that it should not be regarded as a guarantee that the mare would foal. It should be regarded as was the tuberculin test—a useful aid, not an infallible and invariable warranty.

In reply to Mr. Barron, it was possible to use the test for cattle, but it had not given satisfactory results with the other farm animals. Cows did excrete œstrone in their urine, but they showed great irregularity in amount and the time of commencement. In some cases, good positive results were given by pregnant cows at 60 to 70 days: in others, not until 160 or 180 days, by which time pregnancy could usually be diagnosed by clinical means. Consequently, a negative reaction could not be regarded as evidence that the cow was non-gravid. Since it was very important to identify as early as possible those cows which failed to conceive after service, the test could not be of very much immediate use unless it could be modified to do this. He had had no opportunity to test goats, though he believed that German workers had obtained encouraging results.

The question relating to the variation in vitamin E content of grass could not be answered at the present time. The standard vitamin E test employed male and female rats, and it might

present some difficulties to induce them to eat green growing grass in adequate amounts.

Questions relating to the proper time of service of mares, such as those by Mr. Male and Mr. Maynard, were not easy to answer. From Marshall and Hammond's work, confirmed by various other workers, it seemed fairly certain that some 24 hours after the ovum was shed, œstrus ceased. Service should be at such a time that spermatozoa were available to fertilise the ovum as soon after shedding as possible. The rate of migration of sperms through the uterus was rapid—assisted as it was by uterine movements, etc.—and it would seem logical to assume that service should be on the third last or second last day of the œstrous period. The difficulty was, of course, to decide in a given case which exactly were these days. Œstrus normally lasted from three to five or six days, though there were wide variations beyond these limits. In the absence of any means of determining when ovulation was about to occur, it was probably best to have the mare served on the second day after she came into season, and again on the fourth day if she was still in season. In this way the first service would be adequate for mares with a short œstral period and the second for those with a longer one, while the energies of the stallion were conserved better by following this method than when he was used daily during the time a mare was in season. In some studs, it was a usual practice to allow a mare to miss the first œstrous period, but to note carefully how long season lasted. This was used as an indication of how long the next period would last. It was not a very safe guide, however, for some mares might accept service over a longer or shorter period on different occasions. With horses travelling a district, it was obviously very difficult, or impossible, for the stallion to be available at the right time.

He would prefer not to be drawn into a discussion of the relative merits of various forms of treatment for dysfunction of the ovaries. The first essential was an accurate diagnosis, and it would not be possible to make much real progress until such time as there were available accurate methods of testing blood or other body fluids for their hormone content. Then it might be possible to demonstrate a deficiency of this or that specific substance and to correct the deficiency by administering it in a purified form.

Wheat germ oil was a source of vitamin E in concentrated form. It was hardly reasonable to expect it to exert a profound effect upon pronounced pathological conditions, such as endometritis. Other methods of treatment would be more appropriate, such as those advocated by Nielsen and practised by many veterinarians in Britain.

The hormonic control of pregnancy was a very big subject which was not yet by any means thoroughly understood. They would know that it was possible in the ewe and cow to end pregnancy and initiate œstrus by removal of the corpus luteum, but this was not so in the mare which could complete a pregnancy without her ovaries.

There was still some difficulty in determining the best and most suitable vitamin E-rich foods, for livestock; but probably the best material that could be recommended meanwhile was either wheat germ meal or maize germ meal obtained as fresh as possible. Each of these had a reasonable protein content and, apart from the vitamin E content, was a useful meal to add to a mixture. Probably wheat germ meal was slightly superior, but accurate details were not available at present.

The special feeding bone meal to which he had referred, was produced in Scotland from healthy first quality hill lambs only. In it, the proteins and especially the amino-acids of the blood marrow were preserved, and in addition, there was some 8 to 10 per cent. of fat present, which materially aided the absorption of minerals from the alimentary canal. Very good results had attended its use in sheep and cattle, and it was now being tried by various owners of horses with promising results to date. It was definitely superior to steamed or sterilised bone flours, in which the essential proteins were destroyed by the temperatures of the processes to which they were submitted. The name of the firm was mentioned.

In answer to Mr. Craft's observations, Professor Miller said that the essential difference between the blood and urine tests was that in blood the gonadotropic hormone elaborated by the anterior pituitary body was present and was used for the test, while in urine it was œstrone elaborated by ovary and endometrium on which the test depended. The former stimulated the ovary of the immature rat or mouse to produce a follicle (which might be hæmorrhagic) or a corpus luteum, while œstrone induced changes in the vaginal mucosa of the oöphorectomised mouse.

Acid secretions from the vagina had already been mentioned. Regarding aftermath, it did not follow that because aftermath appeared to be strong, luscious and of good feeding quality, it was necessarily so in reality. Ordinary analysis of aftermath showed it to be inferior to early summer and spring grown grass, and he would not be surprised if the vitamin E content was found to vary similarly.

The manuring of grass pastures, and the influence of this and of rotational grazings on grass quality comprised an enormous subject. As they would probably know, this aspect of agriculture was being intensively studied at Jealott's Hill Research Station, and it had been shown that by a combination of sowing grasses of the right strains, proper manuring and correct grazing, results (as measured by the weight of beef or mutton produced per acre) could be enormously improved. Doubtless what applied to cattle and sheep would apply with the necessary modifications to horses, but so far as the specific question went—which led to higher vitamin and salt content, manuring or correct management of grazing—it would be very difficult to say.

In answer to Mr. Begg's question relating to statistics in cattle, Professor Miller said he was not quite sure what kind of statistics were meant, but he presumed Mr. Begg meant records of the number of calves born per hundred services. There were available figures applying to individual herds, and in some cases to bulls, but he did not know of any method giving the results of random sampling of breeding cattle, which would furnish figures comparable to those for the horse.

After abortion, the hormone content of the urine dropped very rapidly, so that by the end of the first 24 hours there was very little œstrone present. It disappeared entirely by the third or fourth day.

He would like to thank the members for the kind way in which they had received the paper and for the helpful discussion which had been contributed.

CAUSATION AND TREATMENT OF MILK FEVER

TWELFTH INTERNATIONAL VETERINARY CONGRESS DISCUSSION

[As the subject of the causation and treatment of milk fever continues to engage much attention, and the present position of veterinary opinion concerning it is well summarised therein, we reproduce the report of the discussion of the papers on parturient paralysis appearing (p. 364, *et seq.*) in Vol. ii of the Proceedings of the Twelfth International Veterinary Congress, New York, 1934, recently issued.]

Professor J. Russell Greig: Since March, 1925, when Dryerre and I enunciated our original theory which postulated that milk fever was, in part, due to an acute hypocalcæmia, much experimental work on the disease has been performed. The experimental evidence furnished later by ourselves and by Little and Wright, Sjollema, Fish and others is now such that there is little, if any, doubt that the milk-fever syndrome is immediately dependent upon acute hypocalcæmia.

This hypocalcæmia can be quickly overcome and the disease as quickly cured either by the injection of readily assimilable calcium salts or by inflation of the udder which, as I was able to report at the Eleventh International Congress at London in 1930, produced its curative effect by its action in raising the blood-calcium concentration. The process of cure is directly related to the rise in the calcium concentration since as the blood calcium rises the symptoms disappear. It is conceivable that so marked a fall in calcium will provoke other disturbances in the general metabolism but, so far, no constant deviation from the normal other than acute hypocalcæmia has been demonstrated in milk fever.

It has been suggested that the blood-calcium deficiency is not the immediate cause of the attack but that it permits the absorption of, as yet, undetermined toxic metabolites which are the actual exciting factors. This may or may not be so. At present such an opinion must necessarily be merely speculative.

It is of greater importance to inquire into the cause of the sudden and catastrophic fall in blood calcium. It should be clearly recognised that in milk fever the cow possesses within her body an abundance of calcium which, however, is contained in the bones. The trouble lies in an inability to mobilise the calcium quickly enough and to transfer it from the skeletal reserves to the blood.

We know how intimately the mobilisation of calcium depends upon parathyroid secretion, and it is further recognised that during pregnancy the calcium of the mother is, so far as may be, conserved so that the needs of the developing fœtus may be met. It has been suggested that during pregnancy the parathyroids are, therefore, relatively quiescent. Then comes parturition, and if this be easy and uncomplicated and if, consequently, the onset of lactation be abrupt and milk secretion profuse (such as occurs in cows after the third calving) there results an urgent demand for the rapid transference of calcium from bones to blood and from blood to milk. It is to be remembered that the colostrum removed from the udder in a single milking contains much more calcium than exists in all the blood at any one time. Unless, then, the parathyroids be active the calcium mobilisation fails; blood calcium falls and the tetany-coma syndrome which has been shown to result from experimentally produced hypocalcæmia is manifested in the condition we call milk fever.

This conception of the pathogenesis of the disease is essentially that postulated by Dryerre and myself. But, again, it is largely speculative, and much further experience must be gained before precise knowledge can be reached.

At present we at the Moredun Institute, Edinburgh, are conducting experiments into rational methods of prevention by means of feeding minerals with and without the addition of substances rich in vitamin D, by the administration during the last week of pregnancy of massive doses of irradiated ergosterol, and by the injection of assimilable salts of calcium immediately after calving. It is yet too early to report upon these experiments as a whole, but it can be said that in the case of highly susceptible cows the subcutaneous injection of one to two ounces of calcium gluconate immediately after calving and preferably repeated 20 hours later, has in the hands of many practitioners proved an effective preventive.

In London in 1930, two years after our introduction of the subcutaneous injection of calcium gluconate as a curative treatment in milk fever, I could report upon only 100 cases in which the treatment had been applied. The results, however, were such that it was even then apparent that a treatment, the efficacy of which was equal to that of mammary insufflation, had been obtained.

To-day I have no hesitation in stating that calcium therapy (exclusive of all other treatment), if properly applied, can be relied upon to effect complete recovery; indeed, many practitioners have now entirely discarded the udder pump. I shall not discuss the several advantages which the new treatment possesses but rather refer to its two disadvantages. These

consist in the high cost of ampouled solutions and in the fact that if solutions are prepared extemporaneously they must be given in relatively dilute form (5 per cent.) and, therefore, the volume of fluid injected, if it is to contain an adequate dose of calcium, must be large (two pints). Such injections were not infrequently followed by considerable swelling and even by abscess formation.

Doctor Hayden, of Cornell, has recently overcome these difficulties by his discovery that boric acid markedly facilitates the solution of calcium gluconate. This marks a distinct advance in the treatment, and I would suggest the employment of the following formula which we have found to prove highly effective: Calcium gluconate, 2 ounces; boric acid, 3 drachms; water, 12 ounces.

The mixture is boiled and thereafter will remain in complete solution for prolonged periods. The solution may be injected at three or four points. The small amount injected at each point and the fact that the addition of boric acid appears to facilitate absorption obviate the occurrence of local irritation at the injection site.

It is preferable to employ subcutaneous rather than intravenous injections, because in the case of the latter the calcium is very rapidly absorbed and rapidly excreted with the consequent possibility of relapse. Frequently it is difficult to make an intravenous injection in a milk-fever case, and if a caustic salt of calcium such as the chloride be employed a slough may result unless the injection is very perfectly performed.

Within the last four years calcium therapy has also proved of specific curative efficacy in the parturient hypocalcæmias of ewes, goats, sows and bitches, and in that condition known as " transit tetany " in the mare.

Favourable reports have been received of its use in the treatment of purpura hæmorrhagica, and it is also being employed experimentally in equine hæmoglobinuria.

In cattle there occur a number of conditions at present classed under the generic name " staggers." A proportion of these yield rapidly to calcium therapy, and it is probable that such cases are associated with hypocalcæmia, though I have no experimental evidence on the matter. On the other hand, many cases of conditions unassociated with hypocalcæmia are erroneously treated by calcium therapy with consequent failure and disappointment.

In Britain, a condition characterised clinically by acute impaction of the rumen and by constipation is frequently met with in cows which possess deep milking qualities and which have been intensively fed for high milk production. In a limited number of such cases which we have examined, the blood calcium concentration has proved to be below the normal range. We know that a lowered blood calcium is associated with paresis of the alimentary tract, and the injection of calcium in such cases is rapidly followed by the resumption of peristalsis.

In conclusion, I am glad to take this opportunity to express the appreciation of Dryerre and myself for the progressive spirit which has prompted the practice of the new treatment on so large a scale by American veterinarians.

Professor G. H. Wooldridge agreed with Professor Götze that the problem of feeding as a preventive of milk fever is the most important one. Therapeutic measures in the treatment of cases of milk fever, important though they are, deal only with the effects of the primary cause. Boutflour, in England, suggests that more intensive feeding of well-balanced foods before calving is likely to prevent the onset of milk fever by providing in advance the large storage of calcium salts and other bodies which are suddenly abstracted by heavy milking after calving. This preparation appears to have reduced the incidence of milk fever in many herds, although it has not been uniformly effective.

As to causation, the speaker agrees that the primary defect is of nervous origin, but he considers it to be of mammary origin rather than intestinal, as suggested by Götze. He suspects the presence of a mammary hormone, as yet undiscovered, and is of the opinion that the train of symptoms will be traceable to a derangement of the functions of that questionable hormone. The success of mammary inflation points to such an origin. He considers calcium deficiency as one of the effects and not the cause of the illness, although it may account for some of the most obvious symptoms. In the absence of effective preventive measures, curative treatment assumes great importance.

In the present state of our knowledge, he recommends a combination of mammary inflation and injection of calcium gluconate, especially as the boracic acid solution of calcium gluconate is reported to obviate the unfortunate sequel of abscess formation. With regard to Dr. Hayden's recommendation of the use of chloral hydrate, the speaker stated that its use was extensively resorted to in England before Schmidt introduced the mammary injection treatment, but it met with most disappointing results. He would not recommend its use in preference to mammary inflation and calcium therapy.

Dr. Norman Wright (Saskatchewan) could not subscribe to the recommendation of the double treatment of milk fever which had been made at that meeting. In his experience those

cases that do not respond to calcium therapy do not respond to mammary inflation.

The cause of milk fever was known. It was established by Greig and Dryerre as being a hypocalcæmia, and their findings had not been successfully contested. They also established the fact, which was to be expected, that the correction of the hypocalcæmia by calcium therapy cured the animal. Such being the case, why not treat these cases scientifically by calcium therapy alone, which had proved more satisfactory in that it effected an even more certain curative response than did mammary insufflation, while it possessed none of the disadvantages associated with the old treatment?

As he had said, those cases that did not respond to calcium therapy did not respond to mammary inflation. In these cases and other typical cases the urine should be tested for acetonæmia, and glucose or chloral hydrate administered.

THE UBIQUITOUS "BOTTLE OF MEDICINE"

Sir George Newman (late Chief Medical Officer, Ministry of Health) in his inaugural address to the Welsh National School of Medicine, had the following timely piece of criticism to pass on the encouragement too often given to their patients by practitioners of human medicine to accustom themselves to think in terms of disease and of drugs. "My submission is," said Sir George Newman, "that doctors should enlarge the narrow purpose of directing their almost exclusive attention to morbid conditions and the remedy of such conditions mainly by means of drugs. Unfortunately this tendency in professional custom has misled public opinion, and the patient himself becomes accustomed to think in terms of disease and of drugs. Hence, there has arisen a pernicious and false reliance on the "bottle of medicine" or its proprietary patents. Literally, millions of pounds are being thus expended; in 1934 57 million prescriptions were issued under the Health Insurance Act. Drugs are sometimes necessary and a pharmacopœia is required. But medication by drugs is, like patriotism, not enough (or easily too much), and we must not lose our way in this direction, or surrender our common sense and neglect our new knowledge and better methods. If I may say so, the widespreading fetish of quackery in its manifold forms may be partly due to the unconscious misdirection of doctors themselves. People are beginning to feel that they need something more than the doctors are giving them and therefore look elsewhere."

Later, in stressing the need for more preventive medicine, the speaker drove his point further home by adding: "We cannot ensure a healthy nation only by 'bottles of medicine,' modern surgery and artificial immunisation. A fuller and deeper appreciation of positive and constructive health is necessary."

Clinical Communications

OSTEO-SARCOMA IN A GREAT DANE

T. L. WRIGHT, M.R.C.V.S.
Putney

Subject.—A Great Dane dog, between four and five years old. Weight now 9 stone 12 lb., but is said to have weighed 11 stone several months ago.

History.—The dog was first attended on September 2nd, when he was suffering acutely from tympany and vomiting. Next day he had improved, but was weak. Instructions were given to keep the dog on a light diet for a week and report any unfavourable symptoms.

On September 8th, an urgent summons was received to attend, as tympany and vomiting had started again. The owner said that the dog had been improving all the week, but as he thought the dog's fæces were small in amount, it occurred to him that "a good dose of castor oil would clear the matter right up." Without seeking further advice, he had given two tablespoonsful of castor oil on September 7th. This caused evacuation of the bowel, but was followed by vomiting and tympany all night, and I was called in on the morning of the 8th. Arecoline hydrobrom. gr. ¼, was given hypodermically, and all food and liquid were withheld. By evening all tympany had gone, and vomiting was much less. A mixture containing bismuth, sodii bicarb. and liq. morph. was given, and vomiting ceased after the first dose. This mixture was continued for three days, with diet of milk foods and plain cake. On the fourth day (September 12th) the diet was changed to raw steak, assisted by acid hydrochlor. dil. 10 minims twice daily, instead of the bismuth mixture. Steady improvement in health and appetite resulted. Up to this time the dog had always been recumbent when visited, and his weight made him not easy to move about.

On September 16th, exercise was advised, and the owner then remarked that the dog was disinclined to walk as he had sprained his left fore leg about a fortnight previously. On examination, heat and slight swelling were found just above the front of the left carpus, causing lameness. The owner was "quite sure" that he saw the dog sprain the leg when running round a tree, because he "was perfectly all right till then and suddenly squealed and held up his left paw, and had had a varying degree of lameness ever since."

Treatment.—Although the lesion was viewed with suspicion, the history given by the owner suggested that treatment should, at least, be given a trial.

First, gentle massage was tried, but the dog

OSTEO-SARCOMA IN A GREAT DANE

resented it. Then a compress with a weak solution of arnica was applied for two or three hours at a time. It was found that when this was removed the dog persistently licked and nibbled the leg and inflamed the skin over the affected area. The owner was told that the condition suggested the presence of malignant growth in the bone, and that if improvement did not take place after alleviation of the irritation in the skin, it would be advisable to have the limb X-rayed. A compress with lotio alba was applied for a few days, and although the skin was soothed, the lameness and general evidence of pain became more marked.

I enclose a skiagraph taken on September 28th—approximately only six weeks after the first symptoms were observed by the owner—which shows very clearly the spicules at right angles to the periosteum, and changes in the bone itself.

* * * * *

UNUSUAL EFFECT OF A FOREIGN BODY IN A COW

W. C. AULD, M.R.C.V.S.
WINCANTON

Subject.—A three-year-old Shorthorn heifer. She had had one calf, and was now being fattened. The heifer was in good bodily condition and had never shown any previous illness.

History.—The heifer was reported to me as having gone suddenly blind.

Examination.—Pulse, temperature, respirations, appetite, fæces and urine were perfectly normal. Blindness in both eyes was definite, although no disease could be traced, and there was no evidence of external injury.

Prognosis.—Hopeful.

Treatment.—Nil. The heifer was kept in a loose box and fed normally.

Course.—Sight began to return on the fourth day, and apparently complete recovery had taken place by the seventh day. The heifer was turned out, and for ten days appeared normal. On the eleventh day she was again brought in, and when I saw her the blindness had recurred. She was continually walking round the box rubbing her head and horns on the wall as she went.

Prognosis.—Now definitely bad.

Treatment.—Four ounces chloral hydrate per rectum: repeated later in the day. As there was no improvement on the following day the heifer was destroyed.

Post-mortem. — *Post-mortem* examination revealed an abscess on the liver (the size of a football), caused by two pieces of wire and a 3-inch wire nail. These were found in the abscess, piercing the liver substance. Four small abscesses (varying in size from that of a pea to that of a walnut) were found in the brain tissue.

Laboratory examination of the contents proved the absence of tubercle bacilli. The carcase was perfectly normal otherwise.

Discussion.—It seems strange that this heifer did not at any time show any symptoms of digestive disorder, and that four secondary abscesses should form in the brain, and none in any other part of the body.

The mystery deepens considerably when it is revealed that two further cases have since occurred on the same farm, running a course exactly similar, and showing the same lesions (with slight variations in the sizes of the abscesses) at *post-mortem* examination. Another similar case was seen by me on another farm, all four being dealt with within a period of two months. In the last case no foreign body could be found, but the abscesses were present as before.

* * * * *

ATROPINE POISONING IN THE GOAT

D. D. OGILVIE

[FOURTH YEAR STUDENT, ROYAL (DICK) VETERINARY COLLEGE, EDINBURGH]

Recorded cases of belladonna poisoning arising from ingestion of *Atropa belladonna* are rare, and some observers go so far as to say that natural poisoning by this plant does not exist. Thus Mercer gives it as his opinion that deadly nightshade in this country is known only as an inhabitant of botanic gardens, and asserts that no true bill has ever been brought against it, or for that matter even against the correlated *Solanum dulcamara*, the common woody nightshade (*Journal of the Ministry of Agriculture*, Vol. xli, No. 12, p. 1235). A statement so sweeping as this makes a consideration of the following case both interesting and instructive.

Late in the evening of August 25th last, a goat was brought into the surgery. In itself, the fact that the animal had shown no tendency to become restive, even when loose on a straw bed in the back of an open and not very well sprung car, indicated at once that the case was a serious one.

Subject.—A light brown British Toggenburg female goat in full lactation.

History.—The history was somewhat difficult to obtain, but the general facts seemed to be as follows.

The animal had been grazing for the past few months in a small field attached to a private house, but the owner had lately gone on holiday, and had left it in charge of a neighbour who

had tethered it in a lane leading up to an estate. The animal had easy access to the hedge at one side, and to a grassy bank. The change of environment seemed at first to benefit the goat, and it ate well on the 24th, the first day of its new surroundings. Next morning, however, it was seen to be ill, and appeared to be in great pain. Attempts to examine it by the temporary owner seemed to be resented by the animal, which was very excitable, trembled excessively, and did not appear to be wholly conscious of its surroundings. The temporary owner considered that the animal "had a chill," and decided not to ask for assistance, but when the condition became worse and the goat refused to rise on prompting, its custodian became alarmed and brought it in for examination. About ten hours had elapsed since the initial observation of symptoms.

Examination.—Examination revealed that the animal was in good general condition, the coat being healthy, and the milk apparently normal. Tympany was marked by wide distension of the flank regions, and movement showed the presence of a large amount of liquid in the abdomen. The temperature was 102·5°F., the pulse very rapid and small, the heart-beat quick and easily felt, the pupils were strongly dilated, and the eyes staring and unseeing. The mouth was dry, and the conjunctivæ were congested. The light reflex was absent, and cutaneous sensibility diminished or nearly non-existent. Delirium was a conspicuous feature, accompanied by almost continual weak crying, but occasionally there were short spasmodic epileptiform convulsions and louder bleating. Respirations appeared to be difficult, and there was marked hyperpnœa. Attempts at emesis, such as had occurred all day, still continued without result. Palpation of the rumen on the left side showed it to be dense and inert. All gastric movements had ceased, although the intestine was still active. The trunk and head were very hot to the touch, but the extremities tended to be cold. A well-marked coma was present, and the animal lay on its side on the operating table, giving no more trouble than an occasional kicking of its legs.

Diagnosis.—Acute impaction of the rumen. Atropine poisoning.

Prognosis.—Very grave.

Treatment.—A small probang was passed, mainly as an exploratory measure. Results in relation to the tympany were not spectacular, but a certain amount of green vegetable matter and coarse woody fibre adhering on withdrawal indicated the nature of the impaction. Unfortunately neither pilocarpine nor physostigmine was at hand to use as a physiological antidote, and one did not feel justified in making use of arecoline to attempt to counteract the atropine. Caffeine citrate, gr. ii, however, was given hypodermically as a stimulant, and efforts were directed at a rather hopeless attempt to remove the cause of the trouble. Rumenotomy was considered, but discarded because of the general condition of the animal. The stomach pump was ineffective. The tympany was reduced by puncture of the left flank and sod. hyposulph. ʒii followed by mag. sulph. ʒiii, administered. The general condition then improved and the animal seemed more at ease. A soap and water enema was given, and quickly resulted in the defæcation of a large amount of liquid. The subject was then warmly clothed, covered in a bed of straw, and left. Two hours later there seemed to have been further improvement, and the animal was given camphor in oil hypodermically, but after a quiet night it died next morning, some twelve hours after treatment was commenced, and about 24 hours after the initial symptoms became apparent.

Post-mortem Examination.—All the proventriculi were firmly impacted with a mass of mixed green leaves, stalks and straws. The mucous membrane of the rumen was extremely loose, and could be peeled off with the finger. It showed a patchy inflammation. The omasum was the most firmly impacted of all. Its laminæ were widely affected with a black type of necrosis and dropped off when touched. The bowel was rather flaccid, and filled with a straw-coloured liquid. The liver was somewhat hard and cirrhotic. The kidneys were normal.

From the mass of ingesta two types of leaves were isolated, those of *Atropa belladonna*, and, as far as could be ascertained, those of *Sambucus nigra*, the elderberry. The deadly nightshade was present in fair quantity, and its identification was verified by a botanist and a veterinary surgeon. Elderberry appeared to be even more abundant. Almost uninjured leaves of both plants were recovered.

Positive proof of the presence of atropine in the intestinal liquid and in the body structures was not secured by isolation of the alkaloid from the urine by Dragendorff's method, or by Vitali's test, or by biological means, but the case was followed as far as an inspection of the tethering area of the goat, when both deadly nightshade and elderberry were found widely in the hedge. Clear marks where the plants had been torn showed that the material had been ingested.

Discussion.—Wooldridge, in his "Encyclopædia," states that belladonna is a frequenter of waste and stony places in chalky districts. He asserts that cases of poisoning by this plant are rare, and are caused only by ingestion of the root. The goat, he says, is resistant to the ingested root, but gives typical symptoms on injection with the alkaloid.

Nunn, in his "Veterinary Toxicology," remarks that ruminants have greater powers of resistance to atropine poisoning than have other animals, but usually avoid ingestion of the plant concerned. He makes special mention of the rabies-like cries already noted.

Boddie asserts that all parts of the plant are poisonous and that cases are not uncommon in the South and Midlands of England, and in this connection it is interesting to note that the location of this record was Warwickshire.

The literature gives various suggestions for treatment. Langdon Brown and Exner advance intraperitoneal injections of adrenalin as a method of delaying absorption of any type of poison from the stomach and gut, and so gaining valuable time, but since this drug causes a general stimulation of the sympathetic nervous system, and atropine gives the same physiological results by paralysing the parasympathetic system, its use seems contra-indicated in this instance.

Sydney Smith advocates stomach lavage with a weak solution of potassium permanganate in cases of atropine poisoning of man. The concentration of pilocarpine requisite to neutralise the effects of atropine is such as to render this agent impracticable in use. Morphine is a partial antidote but its depressive effects are dangerous. Caffeine, according to this author, is the best stimulant here. In the main, treatment is symptomatic.

In conclusion, it may be said that although the case is complicated by the presence of elderberry, a plant which is coming under notice as being suspected of containing or giving rise to prussic acid, it seems clear that the main symptoms here can be considered to have been the result of atropine poisoning. Certain points, such as the advanced and peculiar necrotic changes in the laminæ of the omasum, may perhaps be attributed to the presence of elderberry.

ANIMAL CLINICS IN SCOTLAND

The directors of the Scottish S.P.C.A. announce that a clinic for the treatment of sick animals of the poor has been opened at Haddington, East Lothian. Qualified veterinary treatment will be provided free of cost on presentation of a voucher, obtainable from the county inspector of the Society. Similar arrangements for qualified veterinary treatment have been made at Dunfermline and Kirkcaldy, and are in train at Alloa and elsewhere as occasion seems to demand.

* * * * *

A cat caused a disastrous farm fire at Tattenhall, near Chester, recently. Its fur caught fire when Mrs. O. Mosford was lighting a boiler at the farm at Frog Lane. The cat dashed out into the stack yard, followed by Mrs. Mosford and a maid. They were unable to prevent it from getting into the farm buildings, in which there were 40 head of cattle. The buildings were soon in flames. Thirteen of the cattle were burned to death and 60 tons of produce destroyed.

Annotation

JOHNE'S DISEASE

In this report [(1934). *Bull. Off. internat. Epiz.* **8.** 326-353.] Professor Rinjard summarises the results obtained in the work commenced under Professor Vallée and now so ably carried on by his successors. Much of it has already been described on different occasions, but this general account is of great value to all those interested in the control of Johne's disease.

Twenty years ago Johne's disease was prevalent in only two departments in France, although there were odd infected herds in other parts of the country. It is now a very serious scourge and is known to occur in 41 departments. In one badly infected area, within a radius of 15 miles, 2,000 infected cattle are slaughtered annually and used in the preparation of meat products such as sausages. It is estimated that, in one of the worst affected departments in the north-west of France, in which the disease was unknown 25 years ago, 24,500 (8 per cent.) out of 305,000 cattle are affected annually.

Diagnosis

In the research carried out on intradermal tests by the author and his collaborators the best results have been obtained with johnin prepared by cold extraction, for one month at 0 - 5°C., of a growth from a solid medium, suspended in carbolized distilled water (5 : 1,000), followed by filtration through a Chamberland L1 candle. It is titrated experimentally on cattle and adjusted so that, at a dose of 0·25 c.c., a 1 : 5 dilution of the final product will cause an intradermal reaction in the caudal fold of infected animals.

These workers have found that the reactions produced in infected cattle with such a johnin are specific, but that it does not produce reactions in well-established cases. If the johnin is too rich in active principles its specific value is impaired: this can, however, be re-established by dilution.

They found that with johnin prepared in this way the disease could be detected in the early stage before the infected animals became a source of danger to others and that it could be used successfully for the eradication of Johne's disease.

It has not been possible to make extended observations on the behaviour of animals that have reacted although apparently free from symptoms of infection. In instances, however, in which such animals were kept under observation clinical symptoms developed in due course. The author emphasises that some

animals, although actually infected, do not progress to the stage of showing clinical signs of Johne's disease.

In actual practice the use of johnin tended to produce new centres of disease because reactors were sold in the open market. On this account the laboratory withdrew the issue on the ground that its use would only be permissible when combined with power to control the disposal of reactors.

The following table shows the results of tests carried out on 701 cattle.

Intradermal Tests with Johnin on Cattle Presumed to be Infected.

Name and Address of Veterinarian.	No. of Cattle Tested.	Positive Reactions.	Negative Reactions.	Doubtful Reactions.	Remarks.
Dr. T., at C.B.	20	6	14	—	
Dr. G., at A.	28	6	22	—	
Dr. G., at A.	30	2	28	—	
Dr. G., at E.	15	1	14	—	
Dr. G., at C.	48	5	43	—	
Dr. G., at L.-C.	50	2	48	—	
Dr. G., at N.	37	4	29	4	
Dr. F., at N.	16	2	14	—	
Dr. F., at L.-F.	16	4	11	1	
Dr. F., at L.-F.	17	3	13	1	
Dr. R., at G.	33	4	28	1	
Dr. C., at Y.	12	2	10	—	
Dr. C., at C.	63	7	56	—	
Dr. C., at C.	37	5	32	—	
Dr. C., at C.	12	4	8	—	
Dr. C., at C.	6	4	2	—	
Dr. D., at P.	29	5	24	—	
Dr. D., at A.	46	6	40	—	
Dr. A., at F.	177	8	169	—	
Dr. C., at H.	8	2	6	—	
Dr. B., at P.					
M.G.	164	27	137	—	
M.B.	14	1	13	—	
M.V.	26	6	20	—	
M.A.	24	5	19	—	
M.D.	24	7	17	—	10 infected for 4 years
M.J.	34	7	27	—	20 infected for 4 years
M.P.	5	3	2	—	
M.C.	26	4	22	—	
M.C.	19	2	17	—	
M.R.	32	8	24	—	
Thirty-three owners in three communes C.L.M....	701	85	616	—	

Distribution of Positive Reactions according to Age and Sex

	Males. Reactors.	Females. Reactors.
1 year and under ...	12 ...	3
2 years	15 ...	4
3 years	14 ...	3
4 years	12 ...	1
5 years	9 ...	1
Over 5 years ...	7 ...	4
Total ...	69	16

Immunisation

The author and his collaborators have been working for some years on the production of a vaccine. Preliminary tests on about 50 cattle showed that, with the doses used, it was not possible to produce Johne's disease by subcutaneous inoculation with live culture and attempts were then made to premunise with live bacilli. The aim was the production of a localised, non-spreading, persistent, subcutaneous lesion, in the hope that animals so treated would develop a resistance to infection which would persist as long as the lesion was present. In the earlier work aqueous suspensions were used, but difficulty was encountered in estimating the degree of activity of the resultant local lesion, a point upon which the author lays stress. The best results have been obtained with a culture suspended in an oily excipient mixed with an inert unabsorbable substance such as powdered sandstone.

The vaccine used is made up so that each dose has the following composition:—

Oily excipient (equal parts of vaseline and olive oil) 2 c.c.
Dried culture of Johne's bacillus ... ... 5-15 mg.
Inert powder ... ... 10-20 mg.

In uninfected cattle a lesion develops after 24 hours at the site of inoculation: it is œdematous, hot and painful, and after four to six weeks develops into a nodule varying from the size of a plum to that of an orange, with one or two enlarged lymphatic vessels running towards the adjacent lymphatic glands. A typical nodule is firm when palpated, and the surface is bosselated. When incised, it is found to be composed of fibrous tissue with cavities filled with an oily, yellowish purulent grumous material containing large numbers of the bacilli.

The nodules persist on an average for about a year, limits being six months to four or five years. They disappear more rapidly in young animals than in adults.

Cattle already infected when inoculated, or carrying a nodule as the result of a previous vaccination, react quite differently. In such animals there is a slight local reaction which gradually disappears or there may be local suppuration and evacuation of the contents. Such animals cannot be premunised.

The author emphasises that the manner in which animals react to the vaccine can be used as a means of diagnosis. He has drawn up an eradication scheme and used this test to indicate which individuals can be kept for the purpose of building up a resistant herd. The scheme is as follows:—

(1) To eliminate all cattle that are carrying bacilli.

(2) To maintain a state of premunition in the remainder.

Clinical cases are sold for butchering and the remainder are vaccinated. Those animals which fail to develop typical active nodules are then sold for butchering. The survivors are inspected every one or two months and are revaccinated when necessary. Ordinary hygienic measures are carried out in order to minimise the risk of infection for the vaccinated cattle.

The necessity for revaccination is based on the state of the vaccination lesion and the author emphasises that this is very important. If revaccination is carried out while the nodule is active, the subsequent dose is eliminated and so fails to provoke further resistance. On the other hand, if there is an interval between vaccination and the disappearance of activity in the nodule, the animal is left for a time in a state of susceptibility.

It was not possible to test the value of the scheme on a large scale in closely controlled cattle maintained under experimental conditions, but a large number of ordinary farm herds have been dealt with.

There is not yet sufficient experience to say how soon a herd can be freed from infection by these methods. There are herds, however, in which, over a period of four years, no fresh cases have occurred.

The author emphasises that in assessing the results his judgement is based, in the case of vaccinated animals that have developed clinical signs of Johne's disease, on the condition of the local reaction. The only cases he regards as failures are those in which clinical signs of the disease develop in cattle which still bear an active nodule in which the bacillus can be found.

The following are details of the amount of vaccine that has been used.

		Doses		
1925	185	for	6	herds.
1926	536	,,	17	,,
1927	853	,,	28	,,
1928	1,329	,,	29	,,
1929	803	,,	18	,,
1930	774	,,	24	,,
1931	3,158	,,	63	,,
1932	5,159	,,	115	,,
1933	9,678	,,	260	,,
1934 (only covers vaccination done during 5 months) ...	12,866	,,	336	,,
Total (1925–June 1st, 1934)	35,341		896	

There has been an increasing demand from veterinary surgeons for vaccine, and this is considered to be an indication that it is giving good results.

Ninety veterinary surgeons were asked at the end of 1932 for data concerning the 12,797 cattle dealt with up to that time. Replies were received from 41, dealing with 6,850 animals in 168 herds. The results were as follows:—

(1) In 15 herds, comprising 400 cattle, it was not possible to estimate the value of the vaccine.

(2) Most of the replies gave a favourable report.

(*a*) In 133 herds, comprising 5,650 cattle, the reports were completely favourable.

(*b*) In 20 herds, comprising 800 cattle, some success had been achieved.

The author considers that the above data show that:—

(1) In seven cases out of ten, the incidence was diminished or the disease suppressed.

(2) The principle involved in premunition was never found to be defective. The clinical signs of Johne's disease were not observed in animals in which there was an active nodule.

He considers that the failures were only due to difficulties in applying the method, chiefly in connection with ascertaining the state of the local lesion. There have been odd instances in which clinical signs of Johne's disease developed after as short an interval as three to four weeks following the disappearance of the nodule; it is suggested that these are cases in which the loss of the state of premunition could not be recognised in time for reinoculation to be carried out early enough for a state of premunition to be maintained.

The cases in which vaccinated animals became infected are said to have been very infrequent, and to have occurred in badly infected farms,

This emphasises the importance of minimising the amount of infection.

The data given in the paper are incomplete. They indicate a good measure of success in an investigation carried out on a large scale.

The author emphasises the importance of ascertaining the state of the vaccinal lesion in order to decide when revaccination is to be carried out and also in the course of investigating the cause of failure when treated animals develop the disease. Here there occurs an opportunity for individual judgments to vary and a practical difficulty that will have to be faced.

In field investigations of this nature it is always difficult to obtain all the figures that are required. Those given were obtained from rather less than half of the collaborating veterinarians and cover rather more than half of the cattle and herds dealt with at that time. It would be interesting to know if the results obtained in the remainder of the herds were comparable.

The vaccine was found to be useful in four-fifths of the herds concerning which data are given. W. A. P.

Abstracts

The Effect of Starvation on the Anthelmintic Efficiency of Sodium Arsenite and Tetrachloroethylene. Ross, I. C., and Gordon, H. McL. (1935.) *Aust. Vet. J.* **11.** 3. pp. 106-109. 1 ref.]

Test sheep infected with *Hæmonchus contortus* were divided into five groups. Group 1 were dosed with 50 mg. sodium arsenite in 30 c.c. water, food and water being withheld for 24 hours prior to treatment. Group 2 were treated as group 1, except that food and water were allowed. Group 3 received 2½ c.c. tetrachloroethylene in 2½ c.c. liquid paraffin, food and water being withheld for 24 hours prior to treatment. Group 4 were treated as Group 3 except that food and water were allowed. Group 5 were untreated controls. At autopsy (which was made on some of the sheep only) it was found that, with two exceptions, the drugs had had little effect. The remaining sheep were therefore treated again, using a larger dose of tetrachloroethylene and liquid paraffin, some sheep being fasted and others not, before the treatment. At *post-mortem* examination five days later the treatment was found to have been 100 per cent. effective in two sheep only, one among the fasted and one in the unfasted groups, and that in the other five sheep the effect had been comparatively slight or nil. It was concluded that withholding food and water for 24 hours prior to treatment had no influence on the anthelmintic efficiency of the drugs tested, and the failure of the drugs to act in most of the instances was thought to be due to their entering the rumen instead of going direct to the abomasum. E. L. T.

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Efficiency of certain Drugs Against Hæmonchus contortus. Gordon, H. McL. (1935.) *Aust. Vet. J.* **11.** 3. pp. 109-113. 3 tables. 4 refs.]

Three experiments are here reported. In the first experiment sheep which had been infested experimentally with *Hæmonchus contortus* received doses of sodium arsenite or tetrachloroethylene and were killed seven days later, the worms being collected and counted. Comparison with untreated controls showed the drugs to have been very effective in some sheep and quite ineffective in others.

In the second experiment, similarly-infected sheep were treated with a mixture of carbon tetrachloride and liquid paraffin, or a mixture of sodium arsenite and copper sulphate (200 mg.). *Post-mortem* examination eight days later, when comparison was made with untreated controls, showed the drugs to have had a marked effect. The efficacy of the mixture of sodium arsenite and copper sulphate in the second trial is considered to have resulted from the action of the copper sulphate in closing the œsophageal groove and thus ensuring the direct passage of the sodium arsenite to the abomasum, and not to the anthelmintic action of the copper sulphate itself. [Although the dose of copper sulphate was small, this conclusion seems to be open to some doubt, since copper sulphate alone had a powerful action upon *H. contortus*.]

In the third experiment a mixture of copper sulphate and 40 per cent. nicotine sulphate ("black leaf 40") was tried on sheep infected with *Trichostrongylus* spp. and was found to have an efficiency varying between 7·8 per cent. and 99·9 per cent., as judged by egg counts. The mixture was prepared by dissolving 1 lb. of copper sulphate in 5 gallons of water and adding 16 fluid ounces of black leaf 40: the doses ranged from half an ounce to two ounces. E. L. T.

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Soil, Iron, Copper and Iron in the Prevention and Treatment of Anæmia in Suckling Pigs. Kernkamp, H. C. H. (1935.) *J. Amer. Vet. Med. Assoc.* **87.** 1. 37-58.]

Anæmia of suckling pigs is a name descriptive of one of the principal characteristics, anæmia, of a disease which is widespread throughout the world. Many authors have shown that the conditions favouring its development are those which preclude the consumption by the suckling pigs of soil or its equivalent. The purpose of the experiments described in

this paper was to obtain more specific information on the relation of soil to this disease. The blood changes which occur in the course of the disease can be used as a reliable indication of its progress. In the present investigation the blood examination consisted of a hæmoglobin determination, a total red and a total white blood cell count, a differential leucocyte count and an examination of specially stained smears. Anæmia was produced in young pigs by confining the sows two or three days before parturition in a pen, the floors of which were constructed of concrete. Only enough straw to allow of a comfortable farrowing bed was laid on the floor. After farrowing the sow and the pigs remained in this pen. Of 125 pigs brought up under these conditions 91·2 per cent. developed the typical blood picture of anæmia and 28·9 per cent. died. The decrease in hæmoglobin started in the first week of life and did not return to birth value until the tenth week. It was found that young pigs which had an opportunity of ingesting soil did not show any of the symptoms of anæmia, as far as blood examination could reveal. No difference was found whether the floor of the pen was covered with the soil, either loam or gravel, or whether it was placed in boxes in the pen in such a position as to allow the young pigs access to it. A daily dose of 2,400 g. of soil administered by the mouth was found to be necessary before any sudden increase in hæmoglobin was evident. Another group of pigs were farrowed and reared out of doors and no signs of anæmia developed. It was therefore concluded that soil supplies something which is effective towards preventing the syndrome of anæmia in suckling pigs, but in order that they may benefit from the ingestion of soil the young pigs must begin to consume it very early in life. Experiments with copper-free iron solutions and copper-rich iron solutions tended to show that the primary cause of anæmia in suckling pigs is a deficiency of iron, since administration of this element in amounts equal to 4 or 5 mgs. per kilo. body weight, prevented the disease from developing. The author therefore concludes that it is the iron in the soil which is active in the prevention of anæmia in the experiments described above.

J. S.

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[Supplementing Soil with Iron and Copper for the Prevention of Anæmia in Young Pigs. Moe, L. H., Craft, W. A., and Thomson, C. P. (1935.) *J. Amer. Vet. Med. Assoc.* **87.** 3. 302-311.]

This is a somewhat similar paper to that of Kernkamp abstracted above. Twelve litters of pigs were divided into four groups. Each group was fed and housed similarly on concrete floors. One group was kept free from soil, a second had free access to a 50 lb. quantity of moist soil, a third had access to a similar quantity of soil supplemented with 4·5 g. of ferrous sulphate and 0·75 g. of copper sulphate, while the fourth group had access to a similar quantity of soil but supplemented with 9·0 g. of ferrous sulphate and 1·5 g. of copper sulphate. The soil used contained approximately 250 lb. of easily soluble iron sulphate per acre. During gestation and lactation the sows were fed on a ration containing yellow corn, wheat, tankage and alfalfa (lucerne) meal with a mineral supplement containing ground limestone, bone meal and common salt. Very favourable weather conditions prevailed during the period of the observations. The hæmoglobin level of each group declined between birth and one week of age, but the three treated groups did not decline to the extent of the untreated group. The hæmoglobin level increased in each group between the first and second week. From the first to the fourth week of age those in the treated groups showed a significant rise over those in the untreated group, but there was no significant difference between the unsupplemented soil group and the group receiving soil supplemented with 4·5 g. of ferrous sulphate and 0·75 g. of copper sulphate. The group receiving 9 g. of ferrous sulphate and 1·5 g. of copper sulphate showed significantly higher hæmoglobin values at the third and fourth weeks than either of the other groups. Higher doses of iron sulphate and copper sulphate in similar quantities of soil did not prove any more effective in raising the hæmoglobin level. An average of one pig per litter died from anæmia in the untreated group between the third and fourth weeks but no losses assignable to anæmia occurred in any of the treated groups.

J. S.

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[A New Chemotherapeutic Method in Small-animal Practice. Hoefle, C. (1935.) *J. Amer. Vet. Med. Ass.* **86.** 4. pp. 527-534. 6 figs.]

The author describes the treatment of two dogs by a chemical complex called pyferol, which is a mixture of two solutions: (*a*) a complex ferric salt and (*b*) a dye known as pyrrol (or isamine) blue. The mixture is not stable and must be mixed just before use.

Case 1 was an osteomatous growth on the lower jaw. Two c.c. intravenous doses at three-day intervals were given. After the first injection a slight softening of the growth was noticed and increasing local injections were possible in doses of 0·5 c.c., 1 c.c. and 1·5 c.c., with a gradual reduction again as the growth became smaller and hardened off like normal bone. A microphotograph of a section of the

(*Continued at foot of col.* 1, *p.* 1422)

Reports

CITY OF SHEFFIELD

WORK OF THE VETERINARY DEPARTMENT DURING 1934

The report of the Chief Veterinary Officer, Mr. W. Tweed, for the year 1934 deals with the work carried out under the supervision of the veterinary staff which consists of a Chief Veterinary Officer and two Assistant Veterinary Officers.

Diseases of Animals Acts

The summary of cases of scheduled diseases which were confirmed is given as tuberculosis, 69; anthrax, nil; swine fever, 8; sheep scab, nil; foot-and-mouth disease, 1.

Tuberculosis Order, 1925.—Sixty-nine cows from city herds were dealt with under the Order.

The net amount of compensation paid was £460 10s., or an average of £6 13s. 5d. per animal. The Exchequer grant and salvage received gave a balance of £77 3s. 8d. towards administration.

Swine Fever.—The Officers of the Department act as Local Veterinary Inspectors of the Ministry of Agriculture in the control of the disease. Ninety-nine *post-mortem* examinations were made of pigs during the year. In eleven cases specimens were sent to the Ministry's Laboratory for confirmatory diagnosis and eight were confirmed. Two of these cases were discovered in pigs slaughtered at the Abattoir.

Sheep Scab.—Part of Sheffield was included in a double dipping area on two occasions. One thousand, seven hundred and seventeen sheep were examined by the Veterinary Officers prior to dipping. No case of scab was found. Licences were issued for the movement of 4,774 sheep.

Foot-and-Mouth Disease.—One outbreak confirmed by the Ministry occurred in October amongst pigs on the premises of a farmer. No spread of the disease resulted. Later in the year the city was included in a "movement area" as the result of an outbreak outside the city boundary. Licences were issued in respect of 27,642 animals.

Livestock Markets.—There are two livestock markets in the city at which weekly sales are held. An Officer of the Department attends each sale.

Transit of Animals (Amendment) Order, 1931.—Vehicles to the number of 2,025 were cleansed and disinfected, for which a charge of 6d. per vehicle is made.

Tuberculosis Infection in the Milk Supply of the City

In city herds 5,946 cows were clinically examined for tuberculosis (as coming under the Tuberculosis Order, 1925) and 69 were found to be affected. Of these, 28 were affected with tuberculosis of the udder, the remainder from "other forms." Three hundred and twenty-five mixed samples of milk from city herds were tested biologically and 17 (5·2 per cent.) were found tuberculous.

Of 846 mixed samples of milk examined from country herds, 72 (8·5 per cent.) were found tuberculous. In following up these cases and acting in co-operation with the County Authorities concerned, 1,383 cows were examined and 42 were found affected with tuberculosis of the udder.

Milk (Special Designations) Order, 1923

Two herds in the city are licensed for the production and sale of Grade "A" milk.

Increased interest in tubercle-free cows is noted among city farmers. The difficulty of obtaining progress in this direction is non-breeding in city dairy herds and the supply of tested cows for purchase is limited.

It is pointed out that the tuberculin test should be encouraged as a guarantee against the risk of infection of the milk supply and also against the condemnation of the meat when the animal is sent for slaughter.

Corporation Animals.—The Department is responsible for the supervision of the Corporation animals including horses, cattle, pigs and poultry. In this connection, 114 visits were paid. Eight hundred and eight animals (mostly pigs) were purchased to replenish the stock.

Meat Inspection

Numerous statistical tables are published under this heading.

There are only two private slaughterhouses in the city, the great majority of animals being killed at the Corporation Abattoir.

The following numbers of animals were slaughtered at the private and public slaughter-

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tumour and X-ray and ordinary photographs of the jaw before and after treatment are figured.

Case 2 is described as being like a human case of carcinoma previously observed by the author and involving the whole peritoneal cavity of a bitch with two tumour-like growths in the lumbar region. Operative treatment was impossible through excessive hæmorrhage, and intravenous injection of two c.c. doses of pyferol twice weekly with stimulants, etc., was tried. Resolution of the condition was effected and its course followed by blood counts. An indolent ulcer on the neck healed up. The bitch has since bred five normal pups.

C. V. W.

houses: 32,678 oxen, 15,708 calves, 100,935 sheep, 48,272 pigs.

Eight thousand and thirty-six more animals were slaughtered at the Corporation Abattoir than in the previous year.

The majority of fresh carcases dressed in slaughterhouses outside the city are submitted for inspection at the abattoir; stamped carcases are exempted from further inspection.

The total number of home-killed carcases (with offal) inspected for soundness was 200,909.

The total weight of carcases and part carcases (exclusive of offals) from all sources condemned was just over 71½ tons and condemned offals amounted to 148 tons.

The Corporation pay the butchers 2s. 6d. a cwt. for condemned carcases and 1s. per cwt. for condemned offal for manufacture into by-products.

In no case was seizure and a magistrate's order necessary for the condemnation of meat.

Mechanical Stunning of Animals

Further experimental work was carried out on the use of electricity for stunning. The method is always employed in the stunning of calves, sheep and pigs. On cattle it is only used in the isolation slaughterhouse at the abattoir for, so far, practical difficulties prevent its being used on these animals in the general slaughter halls. Cattle are killed by the captive bolt pistol.

Inspection of Foodstuffs

The food supplies at the wholesale fish and fruit markets, wholesale imported meat shops, wholesale provision premises, retail markets, shops and railway sidings were inspected, entailing 2,008 visits. The quantities of these commodities condemned are given.

A list of prosecutions taken during the year is included. The co-operation and assistance rendered to the Chief Veterinary Officer in carrying out the above work is acknowledged.

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ASSAM

WORK OF THE CIVIL VETERINARY DEPARTMENT, 1934-35*

The report is written by Mr. G. P. Sen, who was in charge throughout the year. Since the close of the year Mr. Sen has retired from the Service and the Government of Assam record their appreciation of his constant efforts to improve the work of the Department.

The Veterinary Investigation Officer of the Province was employed throughout the year. The subordinate establishment consisted of four Veterinary Inspectors and 56 Veterinary Assistant Surgeons.

Disease.—A new system of reporting outbreaks of disease has been instituted, the veterinary staff being made responsible for estimating the mortality. The experiment is being carefully watched. The number of deaths reported was about normal compared with previous years. The "virus alone" method of inoculation against rinderpest has become popular and the staff was found to be inadequate to deal with the demand. The method is still experimental to some extent. The Veterinary Investigation Officer is dealing with this question and others. A full programme of work is being undertaken in various directions. The work at the Veterinary Hospitals and on tour testifies to the value of the veterinary staff very satisfactorily. An increase in their number is stated to be very necessary.

Cattle Farms.—On one of the farms Johne's disease was detected in 1932. A number of animals, proved to be suffering from the disease, were put on a diet of bone meal and, on re-test, were found to give a negative reaction to avian tuberculin.

G. K. W.

* Assam Government Press, Shillong. Price 5 annas.

N.V.M.A. Divisional Reports

SOUTHERN COUNTIES V.M.A.*

MEETING AT SOUTHAMPTON

The Autumn Meeting of this Division was held at the South-Western Hotel, Southampton, on Friday, September 27th, when Professor W. C. Miller, M.R.C.V.S., F.R.S.E., contributed a paper on "The Difficulties and Complications of the Equine Pregnancy Diagnosis Test."

In the regretted absence of the President, owing to indisposition, Major E. S. Martin was voted to the chair, and others present were Messrs. N. S. Barron, G. P. Male, W. F. Maynard, Charles Tyler and J. B. White, together with Messrs. G. Warnock Begg, J. A. Craft, T. A. R. Chipperfield, Colonel Holness, Miss F. M. Pocock, Messrs. K. V. Morgan and K. S. Morgan as visitors.

The minutes of the previous meeting, as published in *The Veterinary Record*, were taken as read and confirmed.

Correspondence.—The Hon. Secretary announced the receipt of: (1) Letters of apology for absence from Sir Frederick Hobday, Miss Cust, Messrs. G. N. Gould, E. R. Harding, C. Pack, H. C. Rockett and J. T. Turney.

(2) A letter from the N.V.M.A. pointing out that only those members of the Society who were also members of the Association were to

* Received for publication November 4th, 1935.

be included when appointing representatives to the Council.

(3) A copy of the Report of the N.V.M.A. Special Committee on Fur-Bearing Animals.

Nomination.—Mr. M. E. White, of Petersfield, proposed by the Hon. Secretary and seconded by Mr. H. C. Rockett, was nominated for election at the next meeting.

Report of Delegate to Royal Sanitary Institute Congress

In submitting his report as delegate to the recent Congress of the Royal Sanitary Institute at Bournemouth last July, the Chairman said that by electing him to attend this Congress as delegate their Society had figured on the list of "learned bodies" that were there represented and as a consequence he also received a vast number of invitations to attend various entertainments and expeditions to places of interest. These could not be said to be of veterinary interest, and as he had neither the inclination nor the capacity for them he did not accept. Apart from the address of the President of the Section of Veterinary Hygiene (Professor R. G. Linton, Ph.D., M.R.C.V.S.) the only item that directly concerned them was the "Review of Legislation dealing with the Public Health Aspect of the Milk Supply," by Mr. J. N. Ritchie, B.Sc., M.R.C.V.S., D.V.S.M., and its ensuing discussion, which was opened by Dr. L. Jordan, Ph.D., M.R.C.V.S. These items would no doubt appear in *The Veterinary Record* in due course; therefore he need only give his impressions of the meeting at which the paper was read. It was held in a large hall, which was nearly filled with delegates (medical men, sanitary officials, members of town councils, and a few veterinary surgeons), their own profession being, as usual, overwhelmed in numbers. What it lacked in quantity was, however, made up for by the fact that the general trend of the discussion emphasised the need for regular clinical examination of dairy herds everywhere by veterinary surgeons, one delegate going so far as to say that they should be given a free hand. Legislation dealing with the public health aspect of the milk supply of England was said to be chaotic because of the lack of compulsory and uniform regulations to clean up the herds. The pros and cons of tuberculin testing and of pasteurisation were put forward by various speakers and there was a good deal of reiteration of facts already well known. The use of ozone to sterilise milk, as an alternative to the uncertain process of pasteurisation, was recommended because it was said to destroy germs without altering the vitamins. He thought he might say that this meeting regarded their profession favourably, and that they did not receive any very adverse criticism.

Mr. White said he would like personally to thank Mr. Martin for attending the Congress as their delegate, as it was by no means easy to get members who were able to do this, and also for the report he had given them.

Mr. Barron seconded this vote of thanks, which was passed unanimously.

Any Other Business.—Major Martin raised the question of the inspection of dairy herds in Hampshire under the Accredited Herds Scheme. He said a panel of practitioners had been formed to make these inspections and had carried out the preliminary inspections, but that although the date was overdue, they had not been asked to carry out the second inspections.

Mr. G. Warnock Begg, County Veterinary Officer for Hants., said he had come to the meeting purely as a visitor, and could only speak in an unofficial capacity. He would like to say, however, that although he was at present carrying out these inspections, he was perfectly willing to co-operate with the panel of practitioners in this work, though up to that time he had not received any official instructions on the matter.

Mr. Male then proposed that either the Society or the panel of practitioners should approach the County Council and suggest that the inspections be made alternately by the County Veterinary Officer and the practitioners.

Mr. Maynard seconded this and the proposition was carried.

Place of Next Meeting.—It was decided to hold the next meeting at Winchester during December, it being left to the President and Hon. Secretary to decide upon the actual date.

Paper.—The Chairman then called upon Professor Miller to give his paper, which was listened to with keen interest by those present, as was obvious by the good discussion which followed. [Professor Miller's paper is reproduced, with a report of the discussion, at the commencement of this issue.—*Editor.*]

The Chairman then proposed a very hearty vote of thanks to Professor Miller for coming down and giving them such an interesting paper on an unusual subject, which provided so much scope for discussion, and also to Mr. Male for opening that discussion.

This was carried unanimously and with applause.

The members then took tea as the guests of Messrs. Facer and Gould, to whom the sincere thanks of the Society are due for their kind hospitality.

J. B. White, *Hon. Secretary.*

Charles Phillips, of Fraddan, Cornwall, has just rescued his thirty-fourth dog from a disused mine shaft. He has been awarded the National Canine Defence League's silver medal in recognition of his courage. In his last effort the dog was being hauled up in a basket from a 120 ft. shaft when it fell to the bottom again and necessitated a second descent by its rescuer.

DERBYSHIRE V.M.A.*

MEETING AT SUTTON BONINGTON

A meeting of the Division was held at the Midland Agricultural College, Sutton Bonington, on Tuesday, October 8th, 1935, when there were present Mr. E. Wilkinson (in the chair), Messrs. Auchterlonie, Durrant, Eaton, Torrance and Ironside. Messrs. R. S. Cockburn and J. S. Sweeney were welcome visitors.

The minutes of the meeting held in April, were read and confirmed.

Arising out of the minutes, and with reference to making arrangements with the R.S.P.C.A. for the treatment of animals of poor persons in Derby, the PRESIDENT said that if the work of destroying animals were given to the R.S.P.C.A. quite a considerable sum could be made towards the financing of free treatment. He pointed out, however, that this work was at present being carried out by the Watch Committee and it was unlikely that they would give it up.

Nominations.—Mr. Wilkinson nominated Mr. G. R. Benbow, Leicester, and Mr. H. Burrow, Derby; Mr. Davidson nominated Mr. R. S. Cockburn.

Correspondence.—Apologies for absence were received from Messrs. Abson, Caldwell and Steele Bodger.

Letters were read from the N.V.M.A. with reference to braxy-like diseases in sheep and to a resolution sent up from the April meeting in 1934. The Secretary was instructed as to the replies to be sent.

ELECTION OF OFFICE-BEARERS FOR 1936

The following were elected:—

President.—Mr. L. A. Auchterlonie.

Past-President.—Mr. E. Wilkinson.

Vice-Presidents.—Mr. H. L. Torrance and Mr. Geo. Eaton.

Secretary and Treasurer.—Mr. W. J. Ironside.

Auditors.—Messrs. Durrant and Evershed.

Council.—Messrs. Bagshaw, Eaton, Durrant, Gunning, Sheffield and Torrance.

W. J. IRONSIDE, *Hon. Secretary.*

* Received for publication October 26th, 1935.

ULSTER SENATE: PASSAGE OF THERAPEUTIC SUBSTANCES BILL

At a sitting of the Northern Ireland Senate on November 11th, the Standing Orders were suspended for that day's sitting for the purpose of enabling the remaining stages of the Diseases of Animals (Therapeutic Substances) Bill to be taken. The report stages of the measure were completed, the Bill received its third reading without discussion, and was passed on the motion of Mr. J. A. Long (Deputy Leader of the House).

Notes and News

The Editor will be glad to receive items of professional interest for inclusion in these columns.

Diary of Events

Nov. 25th.—Meeting of the Editorial Committee, N.V.M.A., at 2, Verulam Buildings, Gray's Inn, W.C.1, at 4 p.m.

Nov. 27th.—Meeting of the West of Scotland Division, at Glasgow, 4.30 p.m.

Nov. 29th.—Meeting of the Royal Counties Division, N.V.M.A., at the Conway Hall, Red Lion Square, W.C.1, at 5 p.m.

Nov. 29th.—Meeting of the Midland Counties Division, N.V.M.A., at Leicester, 2 p.m.

Dec. 4th.—Meeting of the Lancashire Division, N.V.M.A., at Manchester, 2.30 p.m.

Dec. 5th.—R.C.V.S. Written Examinations.

Dec. 6th.—Final Oral Examinations commence in Dublin.

Dec. 9th-20th.—Oral Examinations at Dublin, Glasgow, Edinburgh, Liverpool, London.

1936

Jan. 8th.—R.C.V.S. Committee Meetings. V.V.B.F. Council Meeting.

Jan. 9th.—R.C.V.S. Committee Meetings.

Jan. 10th.—R.C.V.S. Committee and Council Meetings.

Sept. 14th-18th.—N.V.M.A. Annual Congress, Scarborough.

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PERSONAL

Appointments.—Cheshire C.C. has appointed the following as District Veterinary Officers: Mr. Charles A. Stewart, M.R.C.V.S.; Mr. John D. Macbeth, M.R.C.V.S.; and Mr. Bernard Brown, M.R.C.V.S.

Birth.—HARE.—November 13th, 1935; to Joyce, wife of Dr. Tom Hare, of 70, Holywell Hill, St. Albans, the gift of a daughter.

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R.C.V.S. OBITUARY

DALE, William, 60, Hertford Street, and 32, St. Andrew's Road, Coventry. Graduated London, April 4th, 1876; died November 14th, 1935, aged 81 years.

KENNY, Thomas Joseph, Major R.A.V.C. (T.A.), Hall Street, St. Helens, Lancs. Graduated Dublin, December 14th, 1915; died November 13th, 1935, aged 45 years.

PETTY, William Edward, Havant Road, Cosham, Hants. Graduated London, December 18th, 1912; died November 16th, 1935, aged 47 years.

MR. WILLIAM DALE

Mr. William Dale, whose death took place at his residence, 32, St. Andrew's Road, Coventry, after a short illness, was a native of Worcestershire and went to live at Coventry nearly 60 years ago, when he took over the practice of the late Mr. Proctor,

in Hertford Street. He held appointments under the Coventry Corporation, the Warwickshire County Council, and the Ministry of Agriculture. Mr. Dale, who was a well-known figure in Warwickshire agricultural circles, leaves a son (Lieut.-Colonel W. J. Dale, O.B.E., M.R.C.V.S.) who is carrying on the practice, and three daughters.

Mr. J. L. Cormack, M.R.C.V.S., represented the Midland Counties Veterinary Medical Association at the interment.

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Major Thos. Joseph Kenny

Major Thomas Joseph Kenny, who was veterinary surgeon to the St. Helens Corporation, served as a veterinary officer in Palestine during the Great War and had been in St. Helens about 15 years. He leaves a widow and two children.

Major Kenny was accorded military honours at his funeral, which took place at St. Thomas's in Canterbury, St. Helens, the profession and R.A.V.C. being represented by Captain A. H. Leyland, of Prescot, Captain A. C. Shuttleworth, B.SC., M.R.C.V.S., of the University of Liverpool, and Mr. William Nightingale, M.R.C.V.S., of Liverpool.

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GENERAL OBITUARY

Sir Themistokles Zammit

The death in Malta, early in the month, of Sir Themistokles Zammit, C.M.G., M.D, removes an outstanding personality from the world of scientific investigation. "As government analyst at Malta," says *The British Medical Journal*, "he took up his work in the laboratories of the Public Health Department under the then chief medical officer, Caruana Scicluna, who had himself helped Bruce in his preliminary investigations into the ætiology of Mediterranean fever. At this moment, Captain Hughes, who followed Bruce in the serious study of this disease, stepped into the laboratory, and in his turn received much assistance in his researches from Zammit. From the earliest stages of his government service, Zammit was thus in close touch with the development of our knowledge of undulant fever, a fact which made him a tower of strength to the Mediterranean Fever Commission from 1904 to 1907. The discovery of the elimination of the specific micro-organism of the disease *via* the milk of the goat was due to him—and the study of means for the prevention of brucella infections afforded him intermittent occupation throughout his life. His numerous publications on the subject are scattered through English, French and Italian journals; and a note from his pen on the immunisation of the Maltese goat appeared in our own columns only two years ago.

"Previously to the advent of the Mediterranean Fever Commission he had already made his mark in the investigation of an outbreak of malaria in Malta, which he successfully dealt with by tracing the anopheles to its only habitat in the island—a small but deep valley—and there destroying it."

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VETERINARY SERVICES IN BEDFORDSHIRE

At a meeting of the Bedfordshire Agricultural Committee on November 13th, a discussion on veterinary inspection, and the desirability of having a full-time county veterinary service, ended with the rejection, by a majority, of the recommendations of a special sub-committee which had gone into the matter. The argument of the opposing members was that such a service would lead to the disappearance of existing veterinary surgeons.

The scheme which the committee were invited to adopt advocated a whole-time staff, comprising a chief veterinary officer and two assistants, to carry out four routine inspections per annum. Under this system, it was stated, the staff could carry out duties with thoroughness and efficiency, and secure a maximum degree of uniformity, while there would be a saving of over £200.

In support of an amendment in favour of the inspection being carried out by part-time veterinary surgeons, it was urged that if all emoluments were taken away from the present veterinary surgeons, they would not have sufficient to bring in a livelihood, and the village farmer who needed their services would be unable to get them, because they would not be in a position to carry on. It was felt to be advisable to give the part-time workers a further chance to work in association with the County Veterinary Officer before such a drastic change was made. That was the opinion of the farmers in the district.

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DEARTH OF VETERINARY OFFICERS

Notts. County Agricultural Committee reports that Mr. J. S. Steward, one of the Assistant Veterinary Inspectors who was appointed in November last, has secured a more remunerative appointment with another local authority and has tendered his resignation. In this connection the committee points out that considerable difficulty has recently been experienced in obtaining suitably qualified applicants for the post of Assistant Veterinary Inspector and in response to the county council's last advertisement only five applications were received and one candidate only, namely, Mr. Kelly, who secured the appointment, possessed the requisite qualifications and experience. "Owing to the large number of veterinary appointments which are at the present time being made by county councils generally throughout the country there is a dearth of suitably qualified persons to fill the posts and in consequence many local authorities are offering salaries higher than those at present paid by the council in order to attract officers with the requisite professional qualifications and experience. There is also the probability that certain other members of the council's veterinary staff may accept similar but more remunerative appointments with other authorities and it is obvious that frequent changes in the personnel must seriously affect the continuity and efficiency of the work of the veterinary department. Having regard to all the circumstances the committee is of opinion that the existing scale of salaries payable to the council's whole-time assistant veterinary inspectors, which at present commences at £400 and rises by annual increments of £25 to a maximum of £550 per annum, should be revised in order to bring the same more into accord with the salaries paid by other local authorities in the country, and accordingly recommends that the following scale be adopted by the county council in lieu of that at present operative, namely: Commencing salary, £450 per annum rising by annual increments of £25 to a maximum of £600 per annum."

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THE CONTROL OF SHEEP DISEASES

A new departure in the application of measures for the better control of sheep diseases in the North of England has been made possible by the

co-operation of the North of England Division with the Management Committee of the Alan, Duke of Northumberland Memorial Fund.

The Committee is now in a position to supply subscribers to the Fund with sheep biological products, of proved efficiency, at a cost showing a reduction of from 25 to 33 per cent. These products will be obtainable only from members of the North of England Division, N.V.M.A., who have agreed to act as distributors.

No little disappointment and loss has been caused in the past due to the absence of professional supervision over the use of these products in connection with sheep diseases. It is, therefore, to be hoped that the new contacts rendered possible by the scheme, between sheep farmers and veterinary surgeons, will lead to a closer collaboration between them in the attack on sheep diseases. There can be no doubt that such a development will be to the advantage of all concerned.

The North of England Division is represented on the Management Committee of the Memorial Fund, and in welcoming this demonstration of collaboration between kindred interests we would offer our congratulations, and good wishes for the success of the venture, to both organisations.

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SUCCESS OF SHEEP SCAB CAMPAIGN ON THE PENNINES

Flockmasters in Westmorland have been notified of the revocation of the Pennine Range (Movement of Sheep) Restriction Orders. For several years past the Diseases of Animals Committee of the County Council have been battling against outbreaks of sheep scab in the area, particularly on the large unenclosed heafs on the Western slopes of the Pennines.

The efforts of the full-time veterinary surgeon and several "patrol" shepherds appointed to keep a strict account of the movement and dipping of sheep, appear to have been to a great extent successful.

The Agricultural Committee reported at a recent meeting of the Derbyshire County Council that no case of sheep scab was found during the double dipping period carried out in the Peak District in September.

The Ministry of Agriculture has released from the Pennine Range (Movement of Sheep) Order, 1935 (requiring sheep to be dipped before being removed from areas scheduled in the Order), an area comprising the greater part of the Peak District, and, with a view to maintaining the freedom of this area from scab, the Diseases of Animals Sub-Committee propose to make regulations controlling the movement of sheep into the area.

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Sir StClair Thomson on the Defences of the Air Passages

There has been a striking increase of interest recently in the functions of the upper respiratory tract since it has been shown by research workers that the active agents, presumably filtrable viruses, of some of the most prevalent human and animal diseases are capable of setting up infection only when they are introduced into the body by implantation in the nasal mucosa. This subject was dealt with by Dr. Edwards in his review entitled "The etiology of the commoner equine respiratory diseases in relation to recent influenza research," published in a recent number of *The Veterinary Record* (15, 40, October 5th, 1935).

The following summary (reproduced from the *British Medical Journal* of November 2nd) of a lecture given by one of the most distinguished ear, nose and throat specialists will therefore, we feel sure, be appreciated as an introduction by veterinary readers who will undoubtedly wish to follow the rapid progress in knowledge upon the causation of the common respiratory diseases.

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Sir StClair Thomson said, in his recent Semon Lecture delivered under the auspices of the University of London, that 40 years ago he, with Professor R. T. Hewlett, made communications to the Royal Medical and Chirurgical Society and to the British Medical Association on the micro-organisms in the healthy nose and the fate of such organisms in inspired air. The majority of the investigators up to that time believed that "the normal nose was a perfect emporium for micro-organisms." Professor Hewlett and himself, one of them a skilled bacteriologist and the other a rhinologist trained, even in those far-off days, at the fountain-head of aseptic technique, came to a different conclusion—namely, that the presence of pathogenic organisms in the interior of the nose proper was quite exceptional. In the vestibules of the nose, lined with skin and furnished with hairs and sudoriferous and sebaceous glands, micro-organisms were always abundant, but such vestibules were no part of the nasal cavity proper.

What were the microbial forces against which the nose had to guard the human body? Five hundred litres of air were inspired per hour by the average human being. Such a quantity of London air might contain 14,000 organisms. What happened to the invaders, and where were the lines of defence? It had been shown long ago that the air was entirely freed from all germs, not only before arriving in the terminal alveoli, but even before reaching the trachea. Nearly if not all the micro-organisms of the air were arrested before they reached the nasopharynx. Largely this arrest took place in the vestibules of the nose, where the organisms were enmeshed in the mucus-moistened vibrissæ. The first factor of arrest was the secretion of healthy mucus. It not only acted like birdlime in trapping the organisms, but, according to some observers, exerted a bactericidal influence. After arrest in the mucus the organisms were rapidly ejected by the action of the ciliated epithelium.

In the anterior portion of the nose, where the mucosa met the in-rushing inspired air, there was no ciliary activity. Posterior to this the mucosa exhibited active ciliary motion. In the deeper area the coverlet of mucus was moved along, like an intact membrane, chiefly by the action of the cilia, but also by traction; in the anterior, inactive area the movement was by traction and gravity. In the latter area the movement was slow; in the deeper, active area the speed was notably increased. In the posterior two-thirds of its extent the nose might be said to have a new coverlet of mucus every ten minutes; in the anterior one-third, about every hour.

Mucus was composed of mucin 3 per cent., solids 2 per cent., and water 95 per cent. Its osmotic pressure was equal to that of the body fluids, and in reaction it was slightly alkaline or neutral. Nasal mucus was tenacious and yet elastic, extremely pliable and yet resistant to traction. It was moved without friction, and spread in an even, thin, transparent layer. By irritation its flow was increased; helpful if the

irritation was moderate, detrimental if excessive and prolonged. If there was too much mucus the cilia were not able to deal with it, and could be seen waving about under it in a futile fashion. If mucus stagnated over an area of inflammation it might be the means of allowing the bacteria which it had enmeshed to grow luxuriantly.

Dealing with the interaction of mucus and the cilia, he said that the combination of these was the most important weapon in the defence of the air passages; but mucus, if it were not kept constantly on the move by ciliary action, would remain stagnant and become useless, while the cilia without the moist medium of the mucous coverlet would furnish no help in defence. With their multitude of energetic extremities the cilia kept the blanket of mucus on the move, bearing on its surfaces and in its meshes the repulsed invaders. This combined activity was spread over the walls of all the accessory sinuses, the greater part of the nasal cavities, the naso-pharynx, and the back of the soft palate down to a level with the atlas; it started again below the vocal cords and extended downwards through trachea and bronchi to the end of the finest bronchiole subdivisions, only stopping where they expanded into the terminal alveoli. The fluids which bathed the surface of the mucosa were not in health bactericidal, or only very imperfectly so, though this view required some modification, since it had been found that the nasal mucus of an individual with a severe cold yielded a culture in which an extraordinary bacteriolytic phenomenon was observed. The name given to the responsible agent for this effect was lysozone, a widely distributed anti-bacterial ferment, which appeared to play a minor part in the resistance to invasion of the upper respiratory tract.

Ciliary Action

Quoting a good deal of recent work on the subject of ciliary action, he mentioned first of all the vitality of the cilia; their active movements were maintained even after death. A French scientist 84 years ago observed cilia in movement in the trachea of a criminal five or six hours after execution, the temperature being from 8° to 12°C.; in another case, where the temperature was 20°C., the movement did not continue for as long. In a piece of human mucosa removed during operation from a frontal sinus, the activity of the cilia was maintained for 77 hours.

The cilia essentially were elastic fibres in communication with and dependent upon the protoplasm of the cell. According to Schæffer, they were from five to seven microns long. Their length might be taken as about equal to the diameter of a red blood corpuscle. Sharpey was the first to describe the "fanning or listing motion" of the elastic cilium. He it was who likened the movement of cilia *en masse* to the effect produced by wind in a cornfield. Motion photomicrographs suggested not a waving cornfield so much as a multitude of upraised hands, clawing and clutching in one direction. The forward, or effective, stroke had been observed to be five times more rapid than the backward, or recovery, stroke. In the forward movement the tip of a cilium would move with the approximate velocity of one millimetre per second, or twelve feet per hour. Various types of movement were observed in different animals, some of which he illustrated by figures.

With the naked eye the movements of cilia could not be seen; their activity could only be judged by the activity they gave to the visible objects ferried along on the raft of the mucus. The "waving cornfield" or "clawing hands" was the movement known in the laboratory as metachronal rhythm, all the cilia beating at the same rate, but not in the same phase. Ciliary action was not influenced by gravity; it was as rapid uphill as horizontal, and no quicker downhill. As to how the cilia worked in sympathy, in co-ordinated rhythm, and always in the same direction, the lecturer entered upon a picturesque explanation in which he drew upon the analogy of the *Spirochæta balbianii* found in the oyster. The cilia in the human mucosa were firmly anchored together and compelled to keep step and wave in rhythm.

The rate of beat in a cilium was inversely to the size. The lung flagella beat less frequently than the cilia, and the larger cilia more slowly than the smaller. The lecturer mentioned experiments by different workers to test the speed of ciliary expulsion. Proetz, using lipiodol and olive oil, found that healthy sphenoids and ethmoids emptied themselves completely in 96 hours, frontal sinuses somewhat faster, and maxillary somewhat slower.

Cilia Regeneration and Response

In the third edition of a textbook for which the lecturer was responsible, published in 1926, the statement appeared: "The ciliated epithelium, when once destroyed, is never renewed." This statement, in view of recent investigations, must be modified. Here the lecturer referred to the work of Knowlton and McGregor, Coates and Ersner, and Gorham and Bacher. The conclusion to be drawn from these experiments was that although there was complete *restitutio ad integrum* of the mucosa of the maxillary sinus in most cases, the new lining, according to some observers, was composed of low-grade, easily reinfected fibrous tissue. While the experiments manifested the possibility of preservation or complete regeneration of the ciliated lining of a diseased sinus, there could never be too great respect given to ciliated epithelium, the first line of defence. The results obtained by one author (Matwejew) after minor operations on the nose suggested that treatment by cautery or acids tended to prevent regeneration of the mucosa, and might contribute to the development of chronic catarrhal conditions.

An interesting study was opened up by investigating the reaction of cilia to external agents, to surrounding conditions, to general states, and to drugs. Cilia could be stirred to greater activity by mechanical stimulation, such as the touch of a needle. The amount of surgical trauma to which a poor nose might be subjected was good evidence of its tolerance of trauma and the power of its defences. There certainly was a "Providence that shapes our ends, rough-hew them how we will." He had often noticed that operations *per se*, contrary even to the best surgical principles, might prove beneficial. Formerly he had put this down to suggestion, the mental effect on the patient of an operation, enhanced by "the mesmeric influence of a surgeon with a one-way mind." But some authors believed that trauma in itself might be a beneficial factor in chronic conditions, disturbing the equilibrium, breaking the impasse or deadlock of "trench warfare" into which the fight between defender and attacker had stagnated, and producing a local reaction which encouraged

hyperæmia and an invasion of wandering cells. At all events, it was striking to notice how well tolerated, even if not beneficial, operation might be in chronic lesions, when the same surgical procedures would, in analogous acute conditions, entail grave risks.

With regard to the influence of temperature on ciliary action, it had been shown that the greatest frequency of beat was at temperatures between 18° and 33°C. The beat was slowed by lowering the temperature, and all motion ceased at between 12° and 7°. On raising the temperature it was found necessary at 35° to supply fluids owing to evaporation, at 40° motion was retarded, and at 43° to 44° it ceased. These results were from the recent work of Proetz. It was well to remember that the temperature of the nasal mucosa was altered in a patient with infection, or with abnormal metabolic rates, or with vasomotor rhinitis, or with allergy. The importance of intranasal temperature in pathological conditions was suggested long ago by Brown Kelly, and Leonard Hill, Gray, and others had reached interesting conclusions on this subject. The influence of temperature was well summarised by Starling when he stated that rise of temperature, within limits, hastened, and cold slowed, the rate of ciliary movement.

Ciliary Action and General Conditions

It appeared that pus did not necessarily arrest ciliary action. Cilia might be found persisting in their activity in the presence of even the worst sinus infection. In obstructive sinusitis Lowndes Yates had found the cilia not only active but competent, in early cases, to bring about a cure if the mucosa at the ostium was shrunk with cocaine. Proetz could only surmise that bacteria, penetrating at a single point, could grow and spread indefinitely in the submucosa without incapacitating the overlying epithelium. The explanation of this unexpected discovery, according to Negus, might be sought in the observations of Mittermaier, who found that the *p*H of the tissues did not of necessity correspond with that of the secretions. The tissues were flooded with blood, and their reaction approached the normal figure found in blood.

After touching on the effect which conditions of allergy might be expected to have on cilia and their coverlet of mucus, and also relating some rather contradictory investigations on the effect of a vitamin-deficient diet on the rate of ciliary movement, Sir StClair Thomson turned to the question of immunity and ciliary reaction. Certain individuals remained "catarrhal" all their lives, and all individuals suffered more from bronchial catarrh at the two extremes of life—childhood and old age—and less from nasal and paranasal inflammation than when in the prime of life. "The individual immunity will shift with the seven ages. Hence the hay-fever adolescent becomes the asthmatic adult, and the infant, though he may mule and puke in his nurse's arms, never sleeps with his mouth open and does not possess a pocket-handkerchief; while the lean and slippered pantaloon has a frequent dewdrop at the end of his nose and is apt to dribble through his open mouth."

Sir StClair Thomson next discussed the question of the condition of the fluid or mucus in which the cilia lived and moved, and summed up the matter again in the succinct words of Starling, that acids or excess of calcium ions slowed, and alkalis or potassium ions hastened, the rate of ciliary action. With regard to the effects of drugs on ciliary action, he again glanced at a good deal of work, recent and less recent. One observer had recorded that chloroform was more poisonous to cilia than ether, though the cilia survived exposure to either of them. Cilia had been found to fail from lack of oxygen, and also after a stream of carbon dioxide had made the water acid. Some drug experiments by Proetz on the cilia of a portion of excised human mucosa showed that cocaine hydrochloride 2½ per cent. produced little effect, but 5 per cent. stopped ciliary movement in from one to three minutes, and 10 per cent. arrested action immediately.

In dismissing at length the defensive arrangements of the nose, the lecturer said that it helped one to appreciate how important were these protections if it was remembered that a solution of potassium ferrocyanide and iron ammonium citrate, dropped into the nasal cavities of rabbits, reached the surface of the brain within an hour. The importance of keeping these avenues healthy would be realised on studying the careful and detailed work of Logan Turner on septic meningitis and cavernous sinus thrombosis, due to a breakdown of the normal nasal defences. The anatomical vulnerability of the nose must always be kept in mind.

Nasopharynx, Pharynx, Trachea and Bronchi

The nasopharynx had on all its walls the protection of the combined mucus and cilia defence. The upper part was usually sterile, although it was a favourite haunt of the meningococcus. The Eustachian tube, one and a half inches in length in the human subject, was lined with cilia, and was further protected by the arrangement whereby it opened on swallowing. The local defences were not as various and efficient as those of the nose; in health the air had been filtered before reaching it, and a good part of the duty of the upper throat was to serve as the first section of the pipe which carried off the used-up mass of mucus and its load of dead organisms to be expectorated or swallowed.

The pharynx was covered with stratified epithelium and was devoid of cilia, but it contained the lower half of Waldeyer's ring, and was well supplied with mucus. The organisms encountered here were too numerous and various to discuss, but it was ready to deal with them, with the aid of saliva (of which from one to three pounds might be secreted daily). The defensive arrangements of the pharynx arrested and carried off the invaders, to that great destructor, the stomach, the efficiency of which in completing these defences of the airways might be evidenced by its capacity to destroy hæmolytic streptococci. The stomach was constantly at work and generally equal to its task, though doubtless overladen at times by the demands made on its energies by an excessive supply of food and of drink.

Were the tonsils defensive outposts? If so, were they of great importance, and during which ages? Had they a purpose, or were they only vestigial remains? Knowledge of the physiological functions of these glands, which were possessed by most mammals, was lacking.

The air passages below the larynx were not tubes of unvarying calibre. It was sometimes forgotten that the bronchi—and still more the trachea—were possessed of a definite musculature, although more than a century ago the presence of smooth muscle fibre was demonstrated in the bronchial tree by Reisseisen.

The Larynx as a Defender

The larynx was a valuable defender of the human body. By closure it protected the lower airways from invasion, and by the fixation it gave to the chest it strengthened effort. Moreover, when internal defences failed, it was the larynx which gave voice for help. The larynx was unprovided with cilia; these ceased at the level of the atlas, to reappear below the vocal cords. The cords were covered with pavement epithelium, unprovided with glands, but well lubricated, like the area above them, with the mucus which this region supplied. The used-up mucus, bearing its load of arrested dust and organisms, was brought up from the trachea, chiefly along its posterior segment, until it collected in the interarytenoid region in sufficient quantity to excite a cough or simply a swallowing movement. With each act of deglutition the cords were compressed together and the flow of mucus from the ventricles of Morgagni was driven across their surface towards the œsophagus, clearing away with it adherent impurities. At every inspiration the bronchial and bronchiolar musculature was released and the air tubes expanded. At the beginning of expiration the muscle fibres in the air tubes contracted and reduced the lumen of all the tubes, the effect being least marked in the trachea and most pronounced in the smaller bronchi. During a cough this expiratory closure was still more marked, the bronchial walls almost closing, and at the same time shortening. If the bronchial mucosa was at all inflamed the lumen of the finer air tubes might be entirely closed during cough and even during forced expiration. These movements tended to squeeze secretion out of the smaller bronchi.

Should any organisms succeed in passing the larynx they could still be dealt with by the mucous covering and the abundant cilia of the lower tubes, or they might be carried away by lymphatic drainage, or die *in situ*; again, they might be absorbed through the mucosa, and if the organisms were virulent they might enter the blood stream and set up a rapidly fatal infection.

The lowest and last defence against aerial invasion was the alveolar cells. Here the cilia ceased to muster, but the mononuclear cells present in the alveoli were powerful phagocytes.

Dust Invasion

In the final part of his lecture Sir StClair Thomson dealt with the problem of atmospheric dust in the air passages. The airway defenders were able to repulse pathogenic invaders, but others, of little or no clinical importance, such as atmospheric dust, were allowed to effect a peaceful penetration. To deal drastically with a smoke-laden atmosphere was more than our defences could manage.

The efficiency of the nose as a filter in an artificial dust-laden atmosphere varied very much in different individuals. In some not more than 30 per cent. of the particles passed through; in others hardly any dust was arrested. Silicosis had been shown to be much more frequent in miners with marked susceptibility than in those with good nasal filters. The inhalation of dust by the city dweller, giving him a pigmented lung, was, they were told, of no clinical importance, but when this amount was increased, as in coal mines, or when the inhaled dust was not so relatively harmless as carbon, serious pulmonary changes developed. All dangerous dusts had one factor in common—their content of free silica.

The nose in earlier textbooks was regarded as merely the organ of smell, itself considered a vestigial sense. There was little reference to the important respiratory functions of the nose. Yet mouth-breathing had been regarded as a danger in quite early times. It was an Elizabethan poet who said: "See to thy mouth, diseases enter there." North American Indian squaws taught their papooses to keep the mouth closed, though this was not considered as a measure of hygiene, but as a means of avoiding evil spirits which entered through the open mouth. Scientifically conducted experiments had now shown the importance of the nose in normal respiration. However cold and dry the outside air might be, it was raised almost, if not quite, to the temperature of the body, and completely saturated with moisture, while traversing the nose. Respiration through the nose appeared to be the constant rule of infancy and early childhood. Only quite exceptionally, as in laughing and crying, was the mouth used as an additional inlet of air in early life. For adults it might be another matter, and after stressing the importance of the defensive powers of the nose it came as a surprise to be shown patients who for years had lived well and comfortably with little or no nasal defence, not even breathing through their mouths, but through a permanent opening in the neck, and the lungs alone, without the filtering nose, were able to moisten and warm the air they inspired and to deal with the enemies it might contain. (He showed two cases, each with a permanent tracheotomy, and a third in which a complete laryngectomy was performed. The health and spirits of these patients were good; they rarely got "colds," and they believed that they contracted catarrh and bronchitis to a less extent than their fellow-workers.) [In this connection there may be stated the familiar fact that many horses wear tracheotomy tubes for years and remain in health.—Editor, *V.R.*]

In concluding his comprehensive lecture Sir StClair Thomson said that his chief purpose had been to show the complexity and perfection of the defences of the airways, to appreciate their arrangements, their activities, and their compensatory interactions, and to encourage interest in normal processes as a necessary first step to the study of disease.

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DISTRIBUTION OF NEMATODES IN THE SMALL INTESTINE OF SHEEP

J. H. Tetley, of the Massey Agricultural College, Palmerston North, New Zealand, contributes to the September 21st issue of *Nature*, in the form of a letter, information relative to the above well worthy of reproduction in this column.

Mr. Tetley says: "In the course of ecological studies on the nematodes of the small intestine of sheep, particularly during their parasitic existence, it has become apparent that the manner of their distribution throws light upon the relation between host and parasite.

"The jejunum is the favoured region of infection of species naturally occurring in sheep; those of any one genus share a common area, while species of different genera vary in the degree to which their infections overlap.

"In healthy sheep the species: *Cooperia curticei*, *Nematodirus filicollis* *N. spathiger*, *Strongyloides*

papillosus, Trichostrongylus colubriformis, T. vitrinus, have each a normal frequency distribution which retains its identity throughout the period of infection; probably other species normally parasitic in sheep have a similar form of distribution. The position of the peak numbers of each species may vary in different animals, but its relation to those of other species in mixed infections is constant. For example, the peak of infection of *N. filicollis* always occurs at a shorter distance from the abomasum than that of *N. spathiger*, while those of species of different genera tend to array themselves along the intestine in the following order: (1) *Trichostrongylus*, (2) *Strongyloides*, (3) *Nematodirus*, (4) *Cooperia*. With increase of the distance of peak numbers from the abomasum there is a correlated increase in the area of distribution of the greater numbers of a species. Generic differences in this connection are marked.

"From the constancy of the form of distribution in sheep of various ages, under various conditions, at different times of the day and at different seasons, it is concluded that:—

"(1) Neither active nor passive migration on the part of adult worms takes place.

"(2) The site of infection is determined during the larval stage.

"(3) The stimuli causing larvæ to take up their station are present in the contents of the small intestine, and arise in the duodenum at the point of entrance of the bile and pancreatic juice.

"(4) Specific differences in distribution are due to inherent dissimilarities in rates of reaction to the stimuli.

"(5) *Trichostrongylus* spp. respond to stimuli in the abomasum as well as in the jejunum. *T. axei* is sensitive to these, but *T. colubriformis* and *T. vitrinus* are less so, with the result that the populations of the latter two species become divided between the abomasum and the small intestine. Other species found in the small intestine in their passage through the abomasum apparently do not remain there long enough to enable stimuli to have effect upon them.

"There is evidence that in unhealthy animals distribution is erratic.

"*C. oncophora, C. punctata* and an unidentified third species of *Cooperia* are normally parasitic in cattle. In sheep they have an erratic distribution, and this, I believe, is an expression of their inadaptibility to this host."

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BIOLOGICAL APPROACH TO THE STUDY OF EPIDEMIOLOGY

In his presidential address to the section of Epidemiology of the Royal Society of Medicine, Surgeon-Captain S. F. Dudley, R.N., dealing with the above subject, said (reports the *Lancet*) that epidemiology can be studied with advantage as that branch of academic biology which deals with the physiological reactions of parasitic and host groups of organisms to each other. "After paying a tribute to the late Theobald Smith as one of the greatest investigators of host-parasite relationships which are the foundation on which scientific epidemiology is built, Dr. Dudley stated that 'natural selection' was the fundamental theory in biology and if the principle was accepted with all its implications then all biological hypotheses, including speculations on the cause of epidemiological phenomena, must harmonise with the principle of natural selection or be discarded as false. Immunity or resistance to parasitic infection was so variable among members of the same race or species that immunity characters must be represented by many genes in the hereditary mechanism. Insuperable difficulties were often encountered when attempts were made to distinguish inherited or natural immunity from acquired immunity. These difficulties were not rendered any easier when it was realised that immunisability, the potentiality of acquiring immunity, and the durability or permanence of immunity, were also hereditary characters which could be augmented by experience, that is, by contact with specific bacteria or their products. In fact the difficulty of deciding the relative importance of nature and nurture was as great to the immunologist as to the eugenist and social worker. He illustrated these points with the supposed racial immunity of the negro to diphtheria in Africa, where clinical diphtheria is rarely seen and the Schick immunity very high; whereas the negros in the United States exhibits little difference from the European as regards Schick immunity and diphtheria mortality.

"Modern work on gene-mutation mutation rates and X-ray mutations suggests to Dr. Dudley that parasitic variability is a more frequent cause of epidemics and variations in the clinical pictures of disease than most bacteriologists have hitherto been prepared to admit. The multitude of types and varieties into which all bacterial species are now split probably, he said, arose comparatively recently as mutants of a common ancestor; it was likely that many of these parasitic mutants cropped up over and over again and were selected for survival at the moment when the conditions were propitious for their dissemination throughout the host herd. In illustration of this he described some peculiar changes in the relative prevalence of the variants of diphtheria bacilli, virulent and avirulent, 'mitis,' 'intermediate,' and 'gravis,' at different times and places. He also gave examples showing how under apparently identical conditions the carrier rate from meningococci could vary from five to 50 per cent. In contrast to the sexual metazoa, Dr. Dudley continued, the doctrine that acquired characters are never inherited is not strictly true when applied to unicellular organisms, because new inheritable characters can be impressed on certain protozoa and bacteria by their environment. Trypanosomes can be trained to tolerate therapeutic drugs in doses that, previous to their education, would have been immediately fatal, and the trypanosome will retain this drug-resistant character even after passage through the tsetse fly. Parasites, he said, are highly specialised in one character, namely, 'host specificity,' that is, with numerous exceptions each host animal has its own parasitic flora and fauna adapted to that species and no other. Moreover parasites are only adapted to living hosts and cannot compete with the putrefactive and saprophytic organisms which invade their host after death. Therefore the popular fear of getting disease from animals and corpses has little foundation in fact.

"Nevertheless, it is not improbable that certain outbreaks of disease may be due to aberrant parasites who have strayed out of their normal hosts in an endeavour to adapt themselves to a new habitat. Disease and epidemics are not the striking phenomena in wild untouched nature that they are among man and his domestic animals and plants. In wild nature the organisms are in equilibrium with each other and their environment; which means that the average number of each species is more or less constant.

The environment is supporting the maximum number of each species which is possible under the prevailing conditions. The natural fecundity of the species is balanced against the pressure of the environment and there are no vacant places left for the further multiplication of the species. When an animal is increasing in numbers there must be vacant places awaiting occupation in its environment, the struggle for existence is less severe and natural selection less active so that under such circumstances unfit members of the species may be able to escape elimination. There are still many vacant places in man's environment, and in consequence there are still as many left for his parasites. Man has to compete with no other species but his own, and his parasites whose destiny is of course bound up in that of their human hosts. This, said Dr. Dudley, is one reason why man can still multiply and at the same time carry a heavier handicap of disease than any other species; but the chief reason why disease should be the special prerogative of *Homo sapiens* is that he is for ever altering and interfering with his own (and therefore his parasites') environment, and the latter never have time to adapt themselves to one environment before they find themselves in another."

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BREEDING OF CATTLE FOR MILK PRODUCTION

Mr. James Mackintosh, writing on the above subject in the "Farmer's Guide," states that in all countries during the last 25 years records of milk yield and fat percentage have been largely used by breeders of dairy stock in the selection of both cows and bulls, and this practice has undoubtedly contributed to the improvement which has been brought about in the average output of our herds. At least it can safely be said that the use of records has provided a means of accurate measurement of the output of individual cows and has supplied standards whereby we can judge whether the yields obtained are satisfactory or not. A marked development of the science of genetics has also taken place during recent years, and we are now beginning to get a little accurate knowledge of the mode of inheritance of some of the numerous good and bad characteristics of our cattle.

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Messrs. John and Edward Bumpus, Ltd., recently devoted a section of their Oxford Street Store to an interesting little exhibition in support of the Royal Veterinary College Hospital Appeal Fund, the central feature being the impressively autographed "Book of the Nosebag." A portrait of "Brenda" by Donald Wood was on view, together with records and photographs of the 24 veteran war horses who are taking part in the appeal. The names of these chargers appear, along with the autographs of their owners, in the "Book of the Nosebag," which also contains an original drawing by Studdy, a photograph of Hugh Walpole and his favourite dog, a "lucky" sovereign presented by Lord Lonsdale, photographs and route of the "Brenda ride" and photographs of Dr. Griffith Evans on his 100th birthday together with a letter in support of the Fund written by the profession's oldest member.

Advertiser's Announcement

Jeyes' Animal Book.

This booklet stresses the need for the application of hygienic principles in the prevention of diseases of farm animals. It is expressly stated that no attempt has been made to deal, other than superficially, with the treatment of disease, and the farmer is recommended to consult a veterinary surgeon in all cases of doubt.

Probably the chief point of interest to the veterinary profession is that it is claimed that Jeyes' Fluid is innocuous to dogs and all other animals save the cat tribe.

It is also stated to have very beneficial effects when administered internally and special capsules varying in strength from 1 to 15 minims are on the market for use in the treatment of diseases of the dog, sheep and calf.

A copy of the booklet can be obtained free, by mentioning *The Veterinary Record*, on application to Jeyes' Sanitary Compounds, Ltd., 99 Regent Street, London W.1.

Diseases of Animals Acts

SUMMARY OF RETURNS

Period.	Anthrax.		Foot-and-Mouth Disease.		Parasitic§ Mange.		Sheep Scab.	Swine Fever.	
	Outbreaks confirmed.	Animals attacked.	Outbreaks confirmed.	Animals slaughtered as diseased or exposed to infection.	Outbreaks reported by the Local Authorities.	Animals attacked.	Outbreaks confirmed.	Outbreaks confirmed.	Swine slaughtered.
	No.	No.	No.	No.	No.	No.	No.	No.	No.
Period 16th to 31st Oct., 1935	16	17	2	49	4	36	13	108	58
Corresponding period in									
1934	21	24	22	2,800	—	—	32	132	59
1933	15	20	18	1,095	2	4	14	62	59
1932	10	13	1	5	2	3	30	57	34
Total 1st January to 31st Oct., 1935	298	345	48	11,624	90	208	288	1,699	996
Corresponding period in									
1934	318	360	33	3,760	104	172	492	1,423	837
1933	239	273	87	7,805	118	197	299	1,177	742
1932	278	344	13	1,098	111	172	204	1,387	676

Note.—The figures for the current year are approximate only. § Excluding outbreaks in Army Horses.